JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOLUME 39 MARCH 15, 1949 No. 3

ARCHEOLOGY.—*Early flint horizons on the north Bering Sea coast.*[1] J. L. GIDDINGS, JR., University of Alaska. (Communicated by HENRY B. COLLINS.)

The tracing of Eskimos backward in time appears to have reached that inevitable stage where frost-preserved organic materials can no longer be counted upon to supplement stonework. In this announcement of an early flint site in the focal north Bering Sea area, we shall have to forego such excellent and traditional comparative traits as harpoon heads and styles of engraving in ivory and bone, mainly for styles in flaking.

In the course of a search for sound timbers for tree-ring dating in frozen early ruins,[2] extensive excavations were made last summer in two large sites at Cape Denbigh.[3] Underlying the frozen bulk of one of these typical Eskimo middens were found certain culture layers in clays almost wholly lacking organic remains. These clay layers are the subject of this preliminary report. The sites as a whole will be considered here only as much as background demands.

Cape Denbigh is a 10-mile-long basaltic ridge that parallels the shoreline of Norton Sound and is joined to the mainland by a broad neck of flat, low-lying swampland. Steep cliffs line most of the seaward edge of the cape, offering few favorable sites for camps or settlements. The two old sites investigated during the summer, Nukleet and Iyatayet, are both located on slopes well above the water's edge, and only Iyatayet has a constant source of drinking water. Both of these are legendary villages to the Shaktoolik Eskimos and are further marked as sites by their thick covering of bunchgrass, which contrasts with surrounding thickets of alder and nearby tundra slopes. Nukleet, visited by Collins in 1929[4], is an extensive mound that sprawls along slopes above a 70-foot cliff at a favorite sealing point on the south side of the Cape. Excavations of 1948 show that its depth of culture deposit ranges from 2 or 3 feet, in loosely consolidated material at the upper edge, to a maximum of 7 feet in stratified midden near the cliff edge. Preliminary analysis suggests final abandonment of the site in the early seventeenth century, with major periods of building immediately before that and much earlier. The bulk of the earlier period corresponds closely to Early Punuk[5] times on St. Lawrence Island. These conclusions are based on a clear cross-relation of certain traits with those of sites on St. Lawrence Island and in other parts of north Alaska; but a strong local cast, perhaps slanted toward the forested inland areas prevails in Nukleet from early to late. The inland influence is shown, among other traits, in bone counts, which indicate consistently high dependence on caribou; in the use of beaver teeth hafted both as end and side blades as the principal whittling tool; and in the use of birch-bark containers. The mound is solidly frozen beneath a maximum summer thaw of about 2 feet, and offers excellent preservation in such perishables as wood, textile, and skin. Some 200

[1] Received January 3, 1949.

[2] A continuation of a long-range problem last summarized in Giddings, 1948.

[3] This investigation was sponsored by the Arctic Institute of North America in cooperation with the Office of Naval Research, and originated from the University of Alaska. This is part of a program jointly planned with Helge Larsen, curator of the Danish National Museum, whose party worked last season in Bristol Bay. Students and graduates of the University who took part in the field work are S. J. Newcomb, Wendell Oswalt, and Walter Arron.

[4] Collins, 1946, p. 51.

[5] See Collins, 1937; Geist and Rainey, 1936.

samples of building timbers secured for tree-ring dating will be the means of attempting to date culture levels.

Iyatayet site, about 10 miles by water from Nukleet on the north side of the cape, is located on opposite, steep slopes at the mouth of a small but permanent stream. Interest in this site was increased by the presence of many flint chips in shallow tests made at the beginning of the field season. The significance of these chips became apparent, however, only after we had penetrated well into the Nukleet mound. At Nukleet, flint was extremely scarce; evidence of flaking was confined to an occasional crude drill bit and scraper, and a few rejected chips. On the assumption that Iyatayet flaking indicated a site earlier than Nukleet, eight test cuts were laid out and thawing was begun in this new location.

The many chips and implements of flinty material included in the upper layers at Iyatayet were puzzling at first, since it was clear from other artifacts that these deposits were closely related otherwise to middle layers at Nukleet. This anomalous condition was explained only after the discovery of an abundance of such flints concentrated in clay layers below this part of the midden. It appears that the later people to occupy the site had thoroughly mixed the earlier deposits with their own, presumably in digging pits for houses.

Both slopes at Iyatayet are covered with culture deposits containing organic matter in a good state of preservation which vary in depth from 2 to 6 feet. Most of these deposits are frozen, though they do not rest on permafrost (deeply frozen ground), as is the case at Nukleet. The greater occupation of this part of the site seems to have fallen in an Early Punuk period. A later occupation, represented by at least two house pits which are visible from the surface, is more closely related to Western Thule sites of northern Alaska.[6] In some of the tests, a grass level was clearly defined under the well-preserved material.[7] Below this lay clays frozen only in spots.

[6] Collins, 1940, pp. 561–2; Giddings, 1944, pp. 127–130.

[7] Elsewhere the old sod line was missing, presumably because of subsurface digging at the beginning of this stage of the deposits.

The clay base was barren on the west slope of the site, but on the east slope it held 1 to 3 feet of culture deposit. In these clay layers the only remains of an organic nature were lenses of charcoal and paperlike remains of mussel shells and an occasional trace of animal bone. The bones that could be identified as such were usually only brown stains in the clay. In those tests that were on steep slopes no clear stratification was found—a gradual soil creep down these slopes seems to have thoroughly mixed the clay deposits—but the clays are stratified on fairly level ground on a bench 40 to 50 feet above sea level. The clearest of this stratigraphy lay under the floor of house 1.

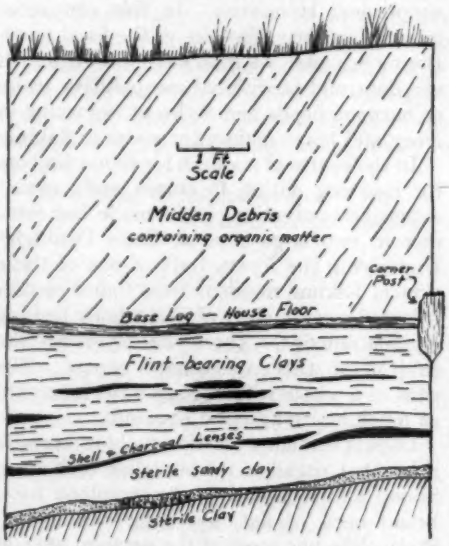


FIG. 1.—Section through north wall of house 1, Iyatayet site.

House 1 perhaps belongs to the period of last occupation of the site. It was a large, rectangular house, 15 by 17 feet in floor plan; and its tunnel opened into the house one-third of the distance from front to rear wall, directly in front of a large fireplace. The house had been floored with split logs and planks laid directly on the clay base of its excavated pit. At the rear of the house floor, the underlying clays were undisturbed. Here was found a clear separation of at least two periods of the clay culture deposits. (Fig. 1.)

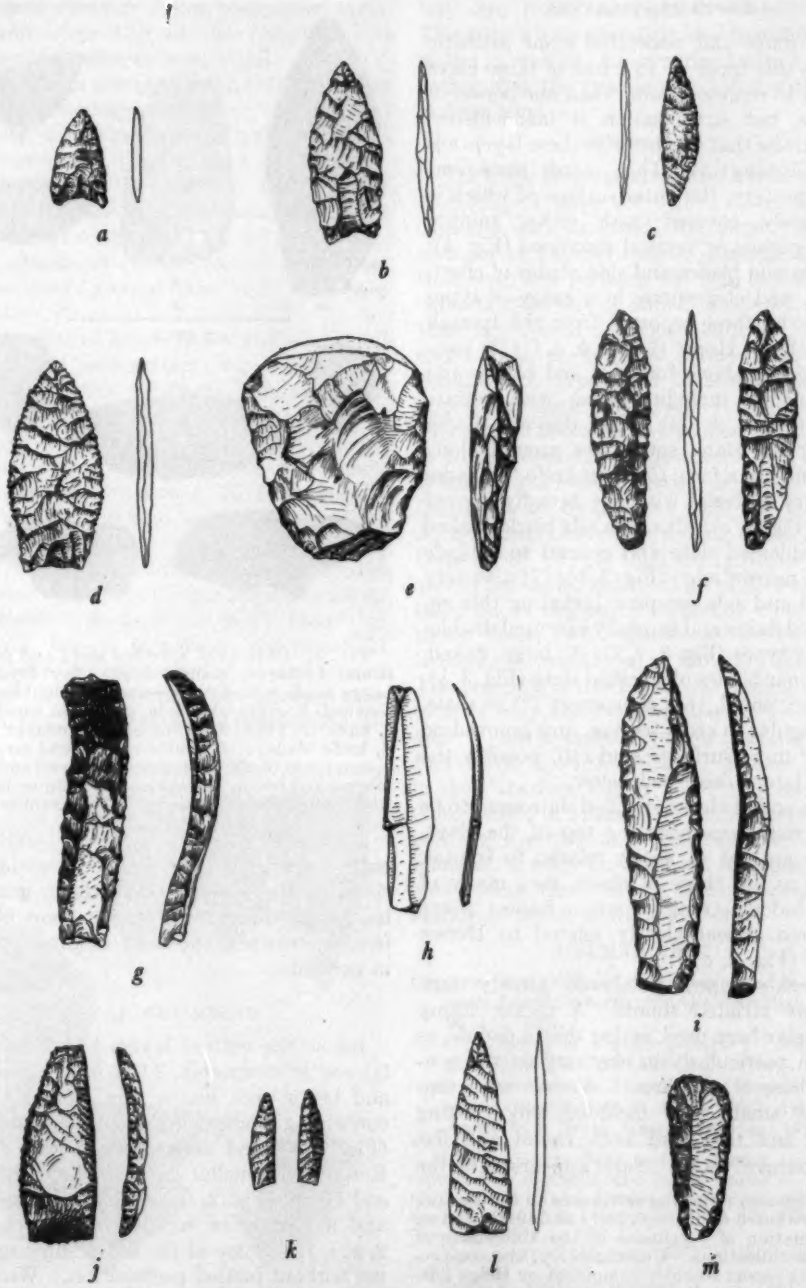


FIG. 2.—Flints, Iyatayet clay layers and microlithic layer.
(*j-l*, natural size; all others four-fifths natural size.)

UPPER CLAY LAYERS

The flints and associated stone artifacts held in the upper 1½ to 2 feet of these clays appear to represent more than one period of culture, but stratification is inconclusive. Some traits that characterize these layers are the following: (1) Thin, hard, sand-tempered pottery, the outer surface of which is completely covered with either minute check-stamps or vertical striations (Fig. 4); (2) thin end blades and side blades of chert, jasper, and chalcedony in a range of types paralleling those reported from the Ipiutak site at Point Hope[8] (Fig. 2, *b*, *c*, *f*); (3) variants of the above forms of end blades and side blades, including some with serrate edges (Fig. 2, *d*); (4) flaked, thin end blades of silicified slate, sometimes ground along the center of a face; (5) short knife (?) blades of flinty material with one broadly convex edge (Fig. 3, *c*); (6) ovate adz blades flaked from silicified slate and ground to a blade at the narrow edge (Fig. 3, *b*); (7) a variety of end and side scrapers, including thin retouched flakes and carefully executed double-convex types (Fig. 3, *e*, *f*); (8) large, flaked, semilunar blades of silicified slate (Fig. 3, *g*); (9) very small, thin sharpeners (?) of shale, rectangular in cross section, and grooved on one or more surfaces; and (10) possibly the stone lamps described below.

The end blades of silicified slate seem to be more numerous near the top of the clays. These are not so closely related to Ipiutak types as are those of chert, etc., many of them having strongly concave bases. Some of these appear closely related to Dorset types (Fig. 2, *a*).[9]

Check-stamped potsherds greatly outnumber striated sherds. A rocker stamp may have been used, rather than a paddle, as shown particularly in checking on the concave base of one vessel. Vessels were uniformly small; they included only cooking pots; and they had both round and flat (or concave) bases. Sand appears to be the only temper. If later detailed examination confirms the absence of feathers, grass or hair, this will prove a strong point of difference between this and Eskimo pottery in general.

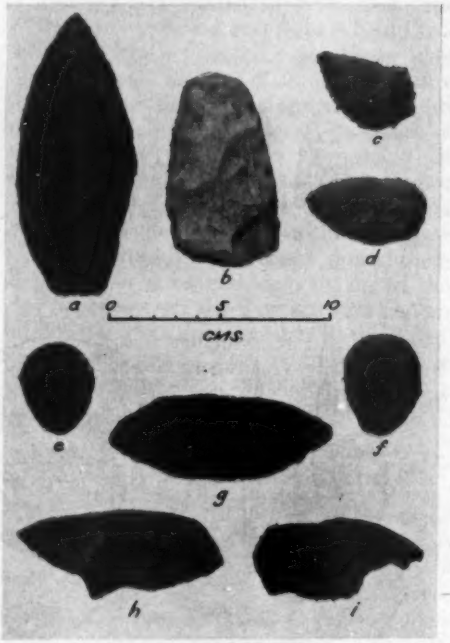


FIG. 3.—Objects of silicified slate and pecked stone, Iyatayet, mainly upper clay layers: *a*, Large blade with three-quarters of the blade retouched; *b*, ovate adz blade, ground at small end; *c*, knife (?) blade with one broadly convex edge; *d*, knife blade; *e*, *f*, double-convex end scrapers; *g*, semilunar blade; *h*, fragment of vessel and shallow pecked basin; *i*, fragment of lamp or mortar with hemispherical basin pecked in granitic boulder.

MICROLITHIC LAYER

Below the culture layers just considered lay sterile sandy clay, 2 to 6 inches in depth, and below that was a thin, gravelly layer containing a large number of lamellar flakes (Fig. 2, *h*), and derivatives of such flakes. Retouched lamellar flakes include leaf-thin end blades (Fig. 2, *l*), side blades (Fig. 2, *k*), and a variety of scrapers or knives (Fig. 2, *g*, *i*, *j*). Some of the flakes show signs of use without further preparation. We found none of the prepared cores from which lamellar flakes were struck, but the plain or

[8] This and following references to the Ipiutak site are based on Rainey, 1941a and 1941b, and on examination of specimens in the University of Alaska collections. Unfortunately, the comprehensive report recently completed by Helge Larsen and Froelich Rainey is not yet received.

[9] See especially Wintemberg, 1939, pl. 6, fig. 2, 5–11.

retouched lamellar flakes themselves make up more than half of the complete and fragmentary objects here found.

This level is distinguished by: (1) Lamellar flaking as a major industry; (2) diagonal retouching of these flakes with almost microscopic precision; (3) flaking of chert, jasper, and much obsidian, to the exclusion of coarser materials; (4) very small ovate and obovate end scrapers (Fig. 2, *m*); (5) arrow-shaft smoothers (?) of grooved sandstone; (6) absence of ground slate; and (7) absence of pottery.

Fragments of large blades, and whole and fragmentary side scrapers, all of chert and related materials, also come from this level. Only one object has been ground. This is an obovate piece of highly silicified metamorphic rock, which fractures like chert; it is carefully retouched on both convex faces and then ground to a strong bevel at the broad end (Fig. 2, *l*). If it is the blade of a composite-headed adz, as the beveled edge suggests, it appears unique among Alaskan adz blades. A type of small lamp (or mortar?) has a cup-sized, hemispherical bowl pecked and smoothed in a small stream boulder of metamorphic or igneous rock (Fig. 3, *i*). Five of these are represented, all but one from unstratified sidehill tests. The only whole specimen was found on top of the microlithic layer under house 1, indicating that the type is associated with this earliest level.

FIG. 4.—Check-stamped and striated pottery. Iyatayet upper clay layers.

EVALUATION

The Cape Denbigh sites offer a remarkable stratigraphic sequence which, when further explored and analyzed, will show regional changes in Eskimo culture through a long time span and perhaps will help explain the cultural base out of which developed more than one North American culture. There seems to be no doubt of a close relation of certain flint types and techniques in the upper clay layers at Iyatayet to those of Ipiutak. The absence of pottery at Ipiutak is to be considered, however. That the Iyatayet microlithic layer is older than Ipiutak is to be inferred from the lack of development of lamellar flaking in the Point Hope site.[10] Types from the Iyatayet clays are, in the main, unlike those of Dorset culture, but a degree of similarity exists between these two cultures as shown particularly in prevalence of lamellar flaking.[11] The presence of much lamellar flaking and a type of very small end scraper at Iyatayet and in such distant inland localities as Fairbanks, in central Alaska,[12] Kluane Lake in the Canadian Yukon Territory,[13] and the Gobi Desert in Mongolia, [14] is an interesting point of speculation. Whatever the interrelations of early far-northern horizons, it is likely that these must finally be traced mainly in terms of work in stone.

BIBLIOGRAPHY

COLLINS, HENRY B , JR. *Archaeology of St. Lawrence Island, Alaska*. Smithsonian Misc. Coll. **96** (1). 1937.

———. *Outline of Eskimo prehistory*. Smithsonian Misc. Coll. **100**: 533–592. 1940.

———. Summary in *A program of desirable scientific investigations in Arctic North America*. Arctic Inst. North America Bull. 1. 1946.

[10] The lamellar flake and its parent core are reported as sporadic and minor traits in other Eskimo and inland Alaska sites of various ages. See summary in de Laguna, 1947, pp. 171–172; also Giddings, 1944, p. 121.

[11] Leechman, 1943, pp. 370–371; Wintemberg, 1939, p. 90.

[12] Rainey, 1939, pp. 387–388.

[13] Johnson, 1946, pp. 183–186.

[14] Nelson, 1937, pp. 267–272.

GEIST, OTTO W., and RAINEY, FROELICH G. *Archaeological excavations at Kukulik, St. Lawrence Island, Alaska*. Misc. Publ. Univ. Alaska **2**. 1936.

GIDDINGS, J. L., JR. *Dated Eskimo ruins of an inland zone*. Amer. Antiq. **10** (2): 113–134. 1944.

———. *Chronology of the Kobuk-Kotzebue sites*. Tree-Ring Bull. **14** (4). 1948.

JOHNSON, FREDERICK. *An archaeological survey along the Alaska Highway, 1944*. Amer. Antiq. **11** (3): 183–186. 1946.

DE LAGUNA, FREDERICA. *The prehistory of northern North America as seen from the Yukon*. Supp. to Amer. Antiq. **12** (3): pt. 2. 1947.

LEECHMAN, DOUGLAS. *Two new Cape Dorset sites*. Amer. Antiq. **8** (4): 363–375. 1943.

NELSON, N. C. *Notes on cultural relations between Asia and America*. Amer. Antiq. **2** (4): 267–272. 1937.

RAINEY, FROELICH G. *Archaeology in Central Alaska*. Anthrop. Pap. Amer. Mus. Nat. Hist. **36**: pt. 4. 1939.

———. *A new form of culture on the Arctic coast*. Proc. Nat. Acad. Sci. **27** (3): 141–144. 1941a.

———. *The Ipiutak culture at Point Hope, Alaska*. Amer. Anthrop. **43** (3): 364–375. 1941b.

WINTEMBERG, W. J. *Eskimo sites of the Dorset culture in Newfoundland. Part* 1. Amer. Antiq. **5** (2): 83–102. 1939.

PALEONTOLOGY.—*New Kansas Lower Cretaceous Foraminifera.*[1] ALFRED R. LOEBLICH, JR., and HELEN TAPPAN, U. S. National Museum. (Communicated by JAMES S. WILLIAMS.)

The writers have in press a paper describing the foraminiferal fauna of the type Kiowa shale of Kansas. As some of the species are also mentioned in another paper in press, which will have prior publication, descriptions of two of the new species and a new generic diagnosis are given here. This is being done in order to validate the names so that they will not appear as nomina nuda.

Genus **Ammobaculites** Cushman

Ammobaculites euides Loeblich and Tappan, n. sp.

Test free, medium in size, early portion coiled, later uniserial, rounded in section; about four chambers in the involute coil, later portion with as many as six uniserial chambers; sutures somewhat obscure in the coil; straight and depressed in the later portion; wall finely arenaceous, surface smoothly finished; aperture terminal, rounded. Length of holotype 0.96 mm., greatest breadth 0.35 mm., greatest thickness 0.19 mm.

Remarks.—A complete series can be obtained of this species, from specimens with only the early coil to specimens with as many as six uniserial chambers. This species differs from *A. coprolithiformis* (Schwager) in being about one-third smaller with specimens of equal development, and in having an initial coil of diameter greater than that of the uniserial portion. In *A. coprolithiformis* the earliest uniserial chambers are much narrower than the coil, the test then flaring with growth, and the chambers also increasing rapidly in height as added. In *A. euides* the initial coil is greater in diameter than the uniserial portion, which increases very little in diameter or chamber height. *Ammobaculites euides* is similar to Upper Cretaceous specimens referred to *A. coprolithiformis* by Cushman, but differs from these in the smaller size, in having comparatively higher chambers, and in having a much more smoothly finished wall.

Occurrence.—The holotype of this species was collected from the Kiowa shale, along the south bluff of the Medicine Lodge River, in the E½ sec. 16, T. 30 S., R. 17 W., Kiowa County, Kans. The species is found also in the Kiowa shale ("Spring Creek" clay) from Spring Draw, in the SE¼ sec. 4, and E½ sec. 3, T. 30 S., R. 18 W., and from the draw in the SE¼ sec. 9, T. 30 S., R. 16 W., Kiowa County, Kans.

Types.—Holotype, U. S. N. M. No. 112528; paratypes, U. S. N. M. No. 112527a–d and University of Kansas collections.

Ammobaculites obliquus Loeblich an Tappan, n. sp.

Test free, medium in size, early portion close coiled, later uniserial and rounded in section; five to seven chambers in the coil, followed by three to four uniserial chambers; sutures straight and obscure in the coil, oblique and slightly depressed in the uniserial portion; wall finely arenaceous, surface smoothly finished; aperture terminal, rounded. Length of holotype 0.86

[1] Published by permission of the Secretary of the Smithsonian Institution. Received February 2, 1949.

mm, greatest breadth 0.32 mm, greatest thickness 0.25 mm.

Remarks.—This species differs from *Ammobaculites coprolithiformis* (Schwager) in being about one-half as large, in having a more compressed coil, and in possessing oblique sutures in the uniserial portion.

Occurrence.—The holotype is from the Kiowa shale along the south bluff of the Medicine Lodge River in the E½ sec. 16, T. 30 S., R. 17 W., Kiowa County, Kans. It is recorded also from the Kiowa shale in the draw in the SE¼ sec. 9, T. 30 S., R. 16 W., and from the Kiowa shale ("Spring Creek" clay) in Spring Draw, in the SE¼ sec. 4 and E½ sec. 3, T. 30 S., R. 18 W., Kiowa County, Kansas.

Types.—Holotype, U. S. N. M. no. 112522; paratypes, U. S. N. M. no. 112521a–c and University of Kansas collections.

Verneuilinoides Loeblich and Tappan, n. gen.

Diagnosis.—Test free, elongate, triserial throughout, with rounded angles, chambers increasing in size toward the apertural end; sutures generally distinct and depressed; wall arenaceous, aperture an arch at the base of the final chamber.

Genotype.—*Verneuilina schizea* Cushman and Alexander (1930: 9)

Remarks.—This genus differs from *Verneuilina* d'Orbigny in having rounded angles, rather than being triangular in section, and in being elongate and narrow rather than pyramidal in shape. The genotype of *Verneuilina, V. tricarinata* d'Orbigny, has a definite pyramidal test, with sharp angles; thus the rounded forms must have a new name. The following previously described species are here referred to *Verneuilinoides: Verneuilina fava* Bartenstein (1937: 183) (Dogger), Jurassic of Germany; *V. schizea* Cushman and Alexander (1930: 9) (Goodland), Lower Cretaceous of Texas; *V. polystropha* (Reuss) (1846: 109) is questionably referred to *Verneuilinoides*. This species was described by Reuss from the Upper Cretaceous of Bohemia as *Bulimina polystropha* with the statement that it had a "very rough surface" although he did not state the wall composition. It was later referred to *Verneuilina* by Parker, Jones, and Brady, and arenaceous forms were so identified by these workers as well as Cushman and Jarvis. Reuss' illustrations do not show the arenaceous character, but as they are somewhat diagrammatic this is not conclusive. Cushman stated that there were no specimens of the species in any of the Reuss collections in Vienna, Dresden, or Cambridge and that he had been able to find none in material from the type locality. Thus it can not be definitely determined whether or not the original material was calcareous or arenaceous. Specimens were referred to *Bulimina polystropha* by Berthelin (1880: 30) from the Albien of Moncley, France, with the statement that the species had a hyaline test, very distinctly perforate. Chapman (1892: 756) recorded *Bulimina polystropha* from the Gault of Folkestone stating, "In the Gault are innumerable examples of a tiny vitreous-shelled Foraminifer, which appears more closely related to Reuss's specimen from the Bohemian chalk . . . than to the recent forms with a sandy test, described under the name of *Verneuilina polystropha* (Parker, Jones, and Brady). The Gault specimens have an abnormal *Bulimine* oral aperture, somewhat semicircular in outline, but their relation to the *Buliminae* appear to be established by the presence of some fine radiating striae round the aperture. This very minute form is one of the smallest in the Gault series, and found only in the finest siftings. . ." Thus both Berthelin and Chapman state that the specimens were calcareous. In addition to the differences in wall character, the Lower Cretaceous specimens of Berthelin and Chapman are much smaller than the Upper Cretaceous form, and the chambers are higher and more globular. Thus the Lower Cretaceous specimens are quite distinct from the arenaceous forms, and probably belong to either *Gumbelitria* or *Bulimina*, the globular chambers and large rounded aperture suggesting the former, although the striations around the aperture mentioned by Berthelin and Chapman suggest a relationship with the Buliminidae. The Upper Cretaceous references to the species other than the original one seem to belong definitely to *Verneuilinoides*, but as the original material is questionable, it does not seem advisable to refer them to Reuss' species. According to Cushman, the Recent references to the species should be placed in *Verneuilina scabra* (Williamson) or in *V. advena* Cushman.

Additional species placed in *Verneuilinoides* are *Verneuilina kurti* Jennings (1936: 12) (Navesink marl), Upper Cretaceous of New Jersey; *V. perplexa* Loeblich (1946: 138) (Pepper formation), Upper Cretaceous of Texas; *V. bearpawensis* Wickenden (1932: 87) (Bearpaw shale), Upper Cretaceous of Canada; *V. parri* Cushman (1936:

2) (Gingin chalk), Upper Cretaceous of Australia; *V. superba* Earland (1934: 118), Recent in the Antarctic; *V. spiculotesta* Cushman (1935: 2), Recent off Puerto Rico; and "*V.*" *cummingensis* Nauss (Cummings member of the Mannville formation), Upper Cretaceous of Alberta, Canada. Nauss (1947: 340) stated, "Further study may reveal that these arenaceous Foraminifera with subcircular cross-section should be considered a new genus. . ." but tentatively referred the species to *Verneuilina*.

The species *Verneuilina schizea* Cushman and Alexander was selected as the genotype for a number of reasons. The writers have a large suite of topotypes of this species and have studied the holotype at the Cushman Laboratory. This species shows all the generic characters well, is quite abundant in the Lower Cretaceous Goodland formation where it occurs, and material from the type locality at the Lake Worth Dam near Fort Worth, Tex., is easily obtainable. Many of the other species referred above to *Verneuilinoides* are extremely rare or from dredgings or well material so that topotypes or representative material cannot easily be obtained by future workers.

REFERENCES

BARTENSTEIN, H. *Mikropaläontologische untersuchungen zur stratigraphie des nordwestdeutschen Lias und Doggers.* Naturf. Ges., Abh. 439 (1). 1937.

BERTHELIN, M. *Mémoir sur les foraminiferes fossiles de l'Etage Albien de Moncley (Doubs).* Mém. Soc. Géol. France, ser. 3, **1** (1). 1880.

CHAPMAN, F. *The foraminifera of the Gault of Folkestone Pt. 3.* Journ. Royal Micr. Soc. (749). 1892.

CUSHMAN, J. A., and ALEXANDER, C. I. *Some Vaginulinas and other Foraminifera from the Lower Cretaceous of Texas.* Contr. Cushman Lab. Foram. Res. **6** (1). 1930.

———. *Fourteen new species of foraminifera.* Smithsonian Misc. Coll. **91** (2). 1935.

———. *New genera and species of the families Verneuilinidae and Valvulinidae and of the subfamily Virgulininae.* Cushman Lab. Foram. Res. Spec. Publ. **6** (1). 1936.

EARLAND, A. *Foraminifera, Part III. The Falklands sector of the Antarctic (excluding South Georgia).* Discovery Reports **10** (1). 1934.

JENNINGS, P. H. *A microfauna from the Monmouth and basal Rancocas groups of New Jersey.* Bull. Amer. Pal. **23** (159). 1936.

LOEBLICH, A. R., Jr. *Foraminifera from the type Pepper shale of Texas.* Journ. Pal. **20** (130). 1946.

NAUSS, A. W. *Cretaceous microfossils of the Vermillion area, Alberta.* Journ. Pal. **21** (329). 1947.

REUSS, A. E. *Die versteinerungen der Bohmischen Kreideformation* **6** (1). 1846.

WICKENDEN, R. T. D. *New species of Foraminifera from the Upper Cretaceous of the Prairie Provinces.* Trans. Royal Soc. Canada, ser. 3, sect. 4, **26** (85). 1932.

ENTOMOLOGY.—*The caddisfly genus Neothremma Banks (Trichoptera: Limnephilidae).*[1] HERBERT H. ROSS, Illinois State Natural History Survey, Urbana, Ill.

Until recently the very interesting genus *Neothremma* has been known only on the basis of the genotype, *alicia* Banks. A few years ago Dr. W. E. Ricker sent me material of a second species, which is of great assistance in giving a little better perspective to the facies of the genus. The two species may be separated by the following key:

Male with lateral process of ninth segment nearly straight, its apical fork vertical in position and with nearly equal arms, Fig. 2; fused claspers elongate and only slightly emarginate at apex, Fig. 2*A*. Female with subgenital plate narrowing toward apex and very deeply and widely emarginate, Fig. 2*B*.....*alicia* Banks

Male with lateral process of ninth segment strongly curved ventrad, the fork horizontal, the inner finger much shorter than the outer, Fig. 1; fused claspers short and tri-emarginate, with a pair of sharp points near the meson, Fig. 1*B*. Female with subgenital plate expanding toward apex, the apical margin obliquely emarginate, with a slightly deeper but small cleft in the middle, Fig. 1*C*.....*didactyla*, n. sp.

Neothremma didactyla, n. sp.

Male.—Length 6.5 mm. Color moderately dark brown, antennae and legs below coxae yellowish brown. General structure of warts, spurs, and venation typical for *alicia*. Maxillary palp subequal in length to labial palp, first and third segments short and subequal, second segment one and one-half times length of third, all three with a sparse mesal brush of fairly long, irregular hair. Front of head with mesal sclerite bearing a patch of sparse setae which have

[1] Received January 7, 1949.

a long thread and a short, flattened, scalelike apex. Tibiae with only a few scattered spines in addition to the tibial spurs. Male genitalia exhibiting the general features of the peculiar type associated with this genus, Fig. 1. Ninth segment narrow dorsally but fairly long laterally, bearing near the middle of the posterio-lateral margin a long sclerotized process (which may represent the cercus), which is strongly curved ventrad and is forked at the tip, the forking being seen best from a posterio-dorsal view, Fig. 1*A*, showing the short inner finger; below this process is a large wide and flat process only half as long as the forked one, and covered with spiculations. The two claspers are fused, and the apical margin of this single structure, Fig. 1*B*, is divided into broad lateral lobes and a pair of closely approximated mesal projections which are pointed and curved dorsad. Tenth tergite forming a pair of closely appressed, heavily sclerotized blades which are very long and curve ventrad, extending beyond the other parts of the genitalia. Aedeagus and its accessory structures forming a short broad structure, the tip of the aedeagus projecting as a slender sclerotized rod.

Female.—Size, color, and general structure typical for male. Maxillary palp normal for family, longer than labial palp, the first two segments short, the next three longer. Front of head without areas of petiolate scales. Genitalia, Fig. 1*C*, having a large single subgenital plate, narrowest at base, its apical margin

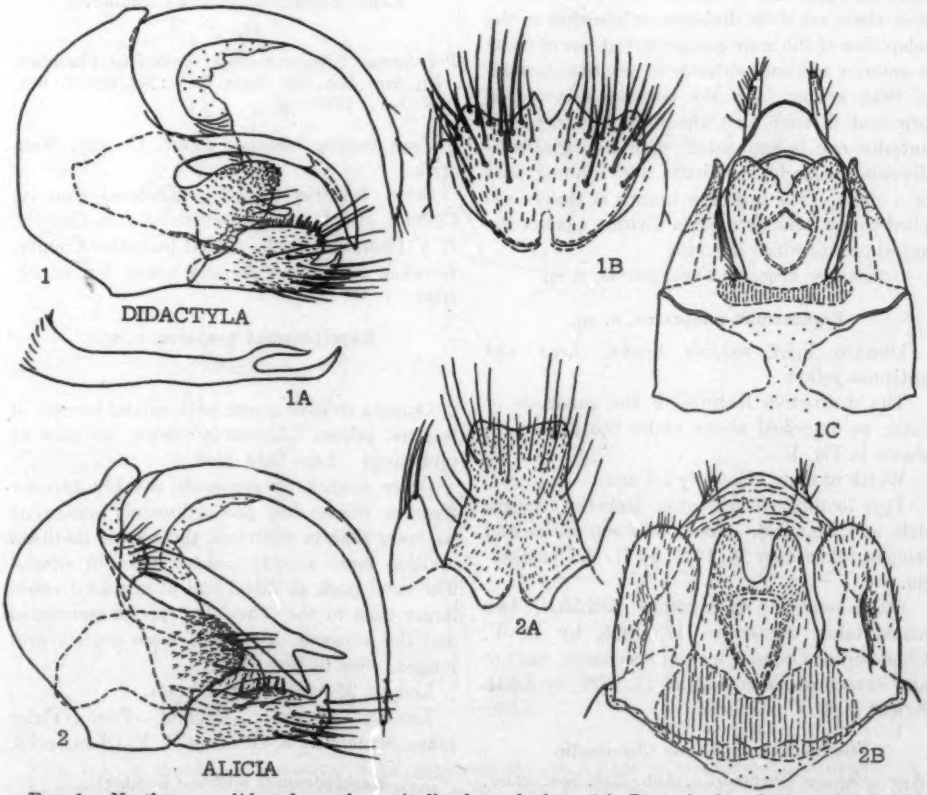


FIG. 1.—*Neothremma didactyla*, male genitalia, lateral view: 1*A*, Posterio-dorsal aspect of forked process; 1*B*, claspers, ventral aspect; 1*C*, female genitalia, ventral aspect.

FIG. 2.—*Neothremma alicia*, male genitalia, lateral aspect: 2*A*, Claspers, ventral aspect; 2*B*, female genitalia, ventral aspect.

incised as shown. Lateral lobes of ninth segment tapering to apex and pointed. Subgenital plate connected to an internal basal sclerotized plate which is small and bandlike.

Types.—Holotype, male: Mount Baker, Wash., along small creek, elevation 6,000 feet, August 29, 1946, W. E. Ricker. Allotype, female, and 9 male and 1 female paratypes: Same data as holotype. Deposited in the collection of the Illinois Natural History Survey.

ZOOLOGY.—*Some millipeds of the families Polydesmidae and Xystodesmidae.*[1]

RALPH V. CHAMBERLIN, University of Utah. (Communicated by C. F. W. MUESEBECK.)

The new forms of millipeds diagnosed and illustrated in the present paper are represented in the author's collection where all types are for the present retained.

Family POLYDESMIDAE

Ergodesmus n. gen.

A genus close to *Nearctodesmus*. The gonopods are short and compact. As in *Nearctodesmus*, there are three divisions or branches in the telopodite of the male gonopods, but one of these is anterior and one posterior in position, instead of both arising from the anterior side of the principal division. Of the three branches the anterior one is segmented, with its distal subdivision slenderly acuminate and forming part of a circle. The posterior branch is closely applied to the main or median division against the apical part of which it curves.

Orthotype: *Ergodesmus compactus*, n. sp.

Ergodesmus compactus, n. sp.

Dorsum light reddish brown. Legs and antennae yellow.

The distinctive features of the gonopods of male, as described above under the genus, are shown in Fig. 1.

Width of male holotype, 2.5 mm.

Type locality.—Washington: Between Goldendale and Mayfield. About a dozen males and females taken May 20, 1941, by R. V. Chamberlin.

Other records.—Washington: Richland, two males taken September 17, 1935, by R. V. Chamberlin; Orondo, several specimens, mature and immature, taken August 11, 1929, by Edith S. and R. V. Chamberlin.

Genus **Kepolydesmus** Chamberlin

Kepolydesmus Chamberlin, Ann. Ent. Soc. Amer. **3** (4): 246. 1910.

Generotype: *Kepolydesmus anderisus* Chamberlin.

A genus distinguished from *Nearctodesmus* primarily in having the outer branch of the telopodite of the male gonopods divided into two segments, which are distinctly separated, as shown in the accompanying figure for *K. hesperus*. Four species are at present known for the genus.

Kepolydesmus anderisus Chamberlin

Fig. 2

Polydesmus (*Kepolydesmus*) *anderisus* Chamberlin, Ann. Ent. Soc. Amer. **3** (4): 246, pls. 36: 6–9, 37: 1–4. 1910.

Type locality.—Idaho: Latah County, Kendrick.

Other localities.—Idaho: Kootenai County, Canyon, and Roselake, Fourth of July Canyon, R. V. Chamberlin coll., 1929; Clearwater County, Kooskia, males and females taken August 23, 1940

Kepolydesmus hesperus, n. sp.

Fig. 3

Dorsum reddish brown with caudal corners of tergites yellow. Antennae brown, in part of pink tinge. Legs light pink.

Outer branch of gonopods notably broader than in *mimus* but proportionately somewhat narrower than in *anderisus*, the apex of its distal division more acutely pointed than in *mimus*. The ectal hook at distal end of middle division larger than in the other two species mentioned and the adjacent distal lobe more acutely prolonged. See further Fig. 3.

Length, 25 mm; width, 3.8 mm.

Locality.—Oregon: Ashland. Four males taken September 9, 1935, by R. V. Chamberlin.

Kapolydesmus mimus Chamberlin

Kepolydesmus mimus Chamberlin, Proc. Biol. Soc. Washington **70:** 10, pl. 10: 3. 1947.

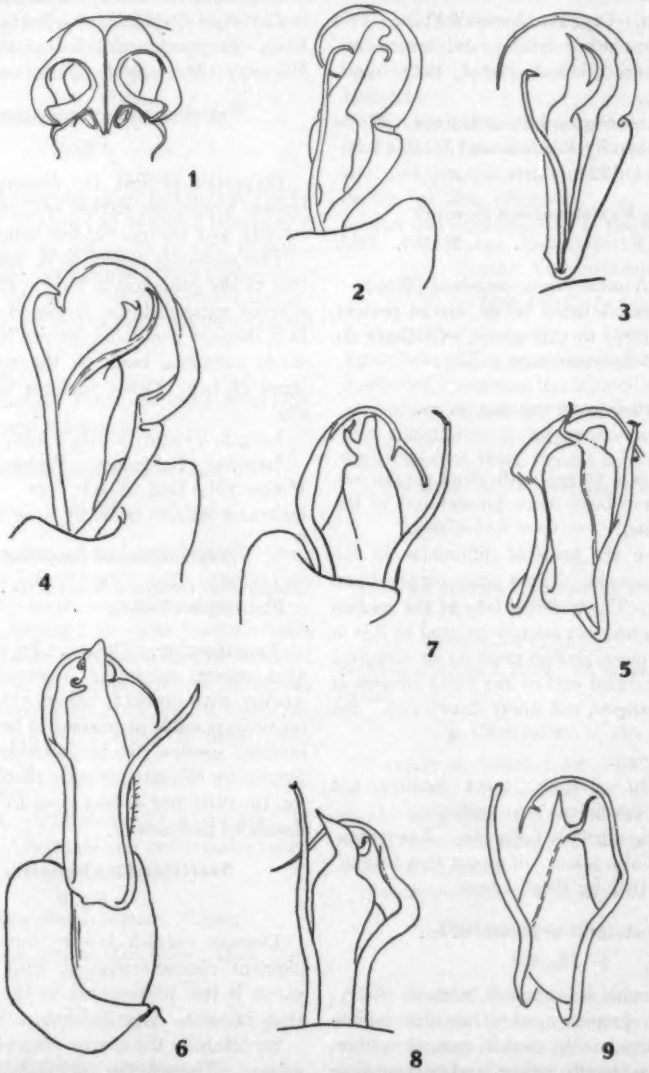
[1] Received January 3, 1949.

Type locality.—Washington: Skamania County Martha Creek at Carson.

Other localities.—Oregon: Canyon Creek, males and females taken September 9, 1935, by R. V. Chamberlin; near Roseburg, males and females, August 30, 1931.

Kepolydesmus pungo, n. sp.
Fig. 4

Dorsum and antennae dark reddish brown. The posterior corners of the tergites yellow as usual. Legs pink or yellow of a decided pinkish tinge.



FIGS. 1-9.—1, *Ergodesmus compactus*, n. sp., gonopods of male; 2, *Kepolydesmus anderisus* Chamberlin, right gonopod of male; 3, *Kepolydesmus hesperus*, n. sp., right gonopod; 4, *Kepolydesmus pungo*, n. sp., right gonopod; 5, *Nearctodesmus amissus*, n. sp., left gonopod; 6, *Nearctodesmus brunnior*, n. sp., left gonopod; 7, *Nearctodesmus campicolens*, n. sp., left gonopod; 8, *Nearctodesmus pseustes*, n. sp., right gonopod; 9, *Nearctodesmus renigens*, n. sp., right gonopod. All anterior aspects.

Of the known species probably closest to *K. mimus*. Distinguishable from that species most readily in the terminal lobe of the principal branch of the gonopods, this lobe being bifid instead of entire and acuminate. For this and other details see Fig. 4.

Width, 3.2 mm.

Type locality.—Oregon: Horsetail Falls. Two adult males, one adult female, and several immature specimens taken August 4, 1929, by R. V. Chamberlin.

Other record.—Oregon: Latourell Falls. Males and females taken by Edith S. and R. V. Chamberlin, August 4, 1929.

Genus **Nearctodesmus** Silvestri

Nearctodesmus Silvestri, Zool. Anz. **35**: 364. 1910.

Orthotype: *Nearctodesmus cerasinus* (Wood)

Seven species, as listed below, are at present known to conform to this genus. Of these six are named and described here as new.

Nearctodesmus amissus, n. sp.

Fig. 5

Dorsum brown, tinged with usual cherry red, which may have been more pronounced in the living specimens.

Set apart on the basis of differences in the gonopods of the male. These much suggest those of *N. pseustes*. The terminal lobe of the median body is shorter and not acutely pointed as it is in the latter; the mesal process presents no subapical tooth and the distal end of the outer process is bent at right angles, not finely drawn out. See further Fig. 5.

Width, 2.8 mm.

Type locality.—Oregon: exact locality not given. Many specimens were collected.

Other record.—British Columbia: Vancouver. Males and females taken "in mossy tree trunks" in September 1932 by Hugh Leech.

Nearctodesmus brunnior, n. sp.

Fig. 6

In contrast with *N. cerasinus*, with its cherry-red color, the present species has the dorsum definitely brown, with caudal corners yellow. The legs are proximally yellow, and darker, more brownish distally. Antennae brown.

In the gonopods the slender outer process, which curves about the free end of the main body, is like that of *N. cerasinus* in having a lateral barb toward distal end, but this is more remote from the apex. The principal body of the gonopod differs from that of *cerasinus* in the structure of the distal end, where it is narrowed and presents two characteristic short processes which curve caudad. See further Fig. 6.

Length, about 24 mm; width, 3 mm.

Locality.—California: 9 miles north of Crescent City. Six specimens taken in the redwoods on Highway 199 by Roth and Brown.

Nearctodesmus campicolens, n. sp.

Fig. 7

Coloration typical, the dorsum being reddish brown, sometimes darker and almost chocolate colored, and the legs reddish yellow or pink.

This species is closest to *N. brunnior* in structure of the gonopods in having the outer branch spurred some distance proximad of the tip, etc. It is distinct from that species in having but a single subapical hook on the median body instead of two. Other features are as shown in Fig. 7.

Length, 24 mm; width, 3 mm.

Locality.—California: Prairie Creek Park, Route 101, Red Wood Fort. July 10, 1940, male and females taken by S. and D. Mulaik.

Nearctodesmus cerasinus (Wood)

Polydesmus cerasinus Wood, Proc. Acad. Nat. Sci. Philadelphia 1864: 6

Type Locality.—Oregon. In view of the fact that several species of *Nearctodesmus* are now known, with probably others yet to be found, it seems impossible at present to be sure of Wood's original species. It is probably not the form figured by Silvestri as such (Zool. Anz. **35**: 364, fig. 10, 1910) but is very close to the species here described as *brunnior*.

Nearctodesmus pseustes, n. sp.

Fig. 8

Dorsum reddish brown, but the cherry-red pigment characteristic of most species of the genus is less pronounced in the type specimen than in most. Legs yellow.

Structurally the species suggests *Kepolydesmus mimus*. Though the gonopods of the male are superficially similar to those of that species, they differ in having the outer branch more sinuous and especially in lacking the submedian break or joint in this branch prominent in *mimus*. The

mesal branch is longer and presents a small subterminal tooth. The principal body is also distally different as shown in fig. 8.

Width of male holotype, 2.5 mm.

Locality.—Oregon: Boyer. Male holotype taken June 13, 1936, by J. A. Macnalb.

Other records.—Oregon: Comstock, seven specimens taken September 16, 1935, by R. V. Chamberlin. Washington: Precise locality not given. One male and an immature specimen.

Nearctodesmus renigens, n. sp.

Fig. 9

Dorsum and antennae brown, the legs yellow.

Similar to *N. brunnior* in having a lateral spur toward distal end of the outer process of gonopods, but readily distinguished from that species in having only one subapical hook on the median body instead of two and in other details as shown in Fig. 9.

Width, 3 mm.

Locality.—Oregon: Probably near Corvallis, male holotype and 2 females.

Nearctodesmus salix, n. sp.

Fig. 10

The metatergites above and laterally rose-colored. Antennae brown. Legs yellow, in some cases partly tinged with pink or rose.

The male is distinct from other known species in the comparatively heavy and furcate terminal portion. The inner ramus without subapical tooth, middle body with main branch extruding farther distad beyond it than is usual. See further Fig. 10.

Width, 3.2 mm.

Type locality.—California: 12 miles west of Willow Creek. One male and two females taken July 9, 1946, by S. and D. Mulaik.

Genus **Pseudopolydesmus** Attems

Pseudopolydesmus Attems, Denkschr. Akad. Wis. Wien **67**: 270, 479. 1898.

Orthotype: *Pseudopolydesmus serratus* (Say).

Pseudopolydesmus caddo, n. sp.

Fig. 11

A small form in which the dorsal tubercules are only moderately developed and in which the lateral margins of the keels show three notches behind the tooth at anterior corner.

Gonopods of the male characterized by having the ectal margin of the blade above middle expanded into a characteristic lamina, as shown in Fig. 11.

Length, 11–12 mm; width, 1.7 mm.

Type locality.—Louisiana: Caddo Parish, 5 miles northwest of Shreveport. Two males and one female taken April 13, 1936, by Leslie Hubricht.

This species is closely related to *P. neoterus* Chamberlin, known from New Orleans, in its size and general structure but differing in the details of the gonopods, e.g., in the lateral lamina and distal portion of the telopodite.

Family XYSTODESMIDAE

Amplocheir, n. gen.

In general structure of body agreeing with *Xystocheir*. The gonopods differ from those of *Xystocheir* in having the telopodite divided by a joint above its middle, the distal segment having two aciculiform spines while proximad of the joint there are three slender spines.

Orthotype: *Amplocheir sequoia* (Chamberlin).

Amplocheir sequoia (Chamberlin)

Figs. 12, 13

Xystocheir sequoia Chamberlin, Bull. Univ. Utah, biol. ser., **6** (5): 15; *3: 28. 1941.

Type locality.—California: Tulare County, Sequoia National Park, 10 miles east of Hammond.

Cheirauxus, n. gen.

A genus separated from *Xystocheir* primarily on the basis of the presence of a fifth spine on the telopodite of the gonopods. This arises on the mesal side from the base of the two larger distal mesal spines.

Orthotype: *Cheirauxus sapiens*, new species.

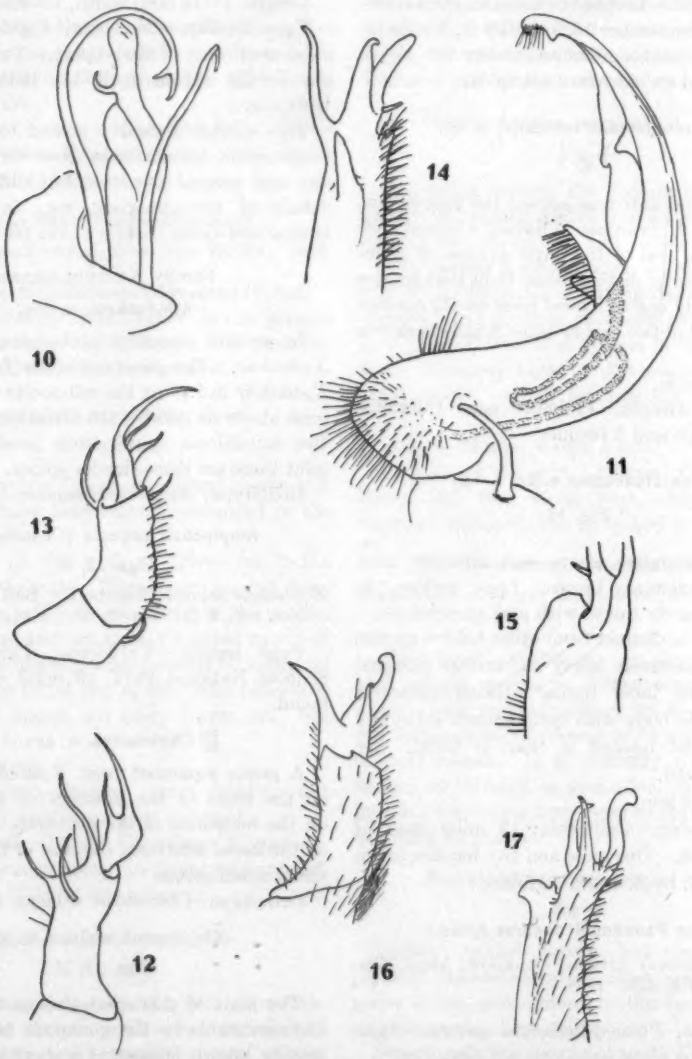
Cheirauxus sapiens, n. sp.

Figs. 14, 15

The male of this species seems to be readily distinguishable in the gonopods from any previously known in bearing a short straight spine on mesal side, just proximad of the point of separation of the two terminal rami, as well as in the details of the other branches as shown in the figures (Figs. 14, 15). Though *Amplocheir sequoia* has a similar supplementary spine, this

in the latter species is much longer and the form and relations of the principal rami are obviously different.

In size and proportions like *X. acuta* Cook with the lateral carinae similarly strongly and acutely produced. It might prove to be the same as Cook's species, but it seems hardly possible that this observer would have overlooked the characteristic supplementary spine mentioned above.



FIGS. 10–17.—10, *Nearctodesmus salix*, n. sp., left gonopod, anterior aspect; 11, *Pseudopolydesmus caddo*, n. sp., right gonopod, mesal aspect; 12, *Amplocheir sequoia* (Chamberlin), right gonopod, anterior aspect; 13, *Amplocheir sequoia* (Chamberlin), right gonopod, subectal view; 14, *Cheirauxus sapiens*, n. sp., left gonopod, distal portion of telopodite, anterior view; 15, *Cheirauxus sapiens*, n. sp., right gonopod, distal portion of telopodite, ventroectal view; 16, *Delocheir taibona* (Chamberlin), left gonopod, subanterior aspect; 17, *Delocheir taibona* (Chamberlin), left gonopod, distal portion of telopodite, submesal aspect.

Length, 34 mm; width, 6.4 mm.

Type locality.—California. Palo Alto. Male holotype taken in 1928 by R. V. Chamberlin.

Delocheir, n. gen.

Differing in the male gonopods from *Xystocheir* in having the anterior finger or ramus replaced by a lamina or thin transverse plate.

Orthotype: *Delocheir taibona* (Chamberlin)

In addition to the generotype the two new species diagnosed below belong in this genus.

Delocheir taibona (Chamberlin)

Figs. 16, 17

Xystocheir taibona Chamberlin, Ann. Ent. Soc. Amer. **5**: 170; *10: 1, 2. 1912.

Type locality.—California: Region of Monterey Bay (Pacific Grove, etc.).

Delocheir conservata, n. sp.

Fig. 18

Related to *D. taibona* but apparently lighter colored, the dorsum pale fawn-colored with keel yellow. Legs light yellow. Keels normal; the processes of those of eighteenth tergite with apices in line with those of the nineteenth.

From *taibona* conspicuously different in the gonopods. In these the posterior terminal spine is long and sigmoidally curved, much exceeding the adjacent median spine, relatively much longer than in *taibona* and differently shaped. The anterior lamina broad, its margin evenly rounded and entire, lacking the conspicuous notch present in the other two species. See further Fig. 18.

Length, about 28 mm; width, 6 mm.

Type locality.—California: Monterey County, Hastings Reservation. A male and female taken separately on April 9, 1938, and March 25, 1938.

Delocheir dalea, n. sp.

Fig. 19

Close in general structure to *D. taibona*, with which it agrees in having the lower or anterior (ventral) finger or ramus of *Xystocheir* replaced by a thin transverse membrane or lamina. It is readily distinguishable from that species in the form of the posterior terminal spine of the gonopods this being relatively much shorter and ending in a characteristic lamina. The transverse membrane lacks the notch present in that of *taibona* and *conservata* toward its outer end. For these and other differences in detail see Fig. 19 in comparison with Figs. 16 and 17.

Dorsum and legs brown. Keels of tergites of posterior part of body produced in degree usual in *Xystocheir;* processes of eighteenth segment nearly attaining level of apices of those of the nineteenth.

Length, about 37 mm; width, 6.5 mm.

Type locality.—California: Brookdale. Males and females taken March 13, 1913, by R. V. Chamberlin.

Genus **Xystocheir** Cook

Xystocheir Cook, Harriman Alaska Exped. **8** (1): 53. 1904.

Orthotype: *Xystocheir acuta* Cook.

Xystocheir francisca, n. sp.

Fig. 20

This is the smallest of the known species of *Xystocheir.* The color above is light testaceous-brown in the preserved specimen. The lateral keels are only moderately produced, with the apices of processes narrowly rounded.

The gonopods of the male seem distinctive. In these the posterior terminal spine is lamellate and curves conspicuously mesad across the erect anterior one; the anterior ramus is proportionately short, bends strongly ectad above base and is expanded at distal end. See further Fig. 20.

Width, 5 mm.

Type locality.—California: San Francisco. Male holotype taken by C. C. Cross.

Xystocheir milpitas, n. sp.

Figs. 21, 22

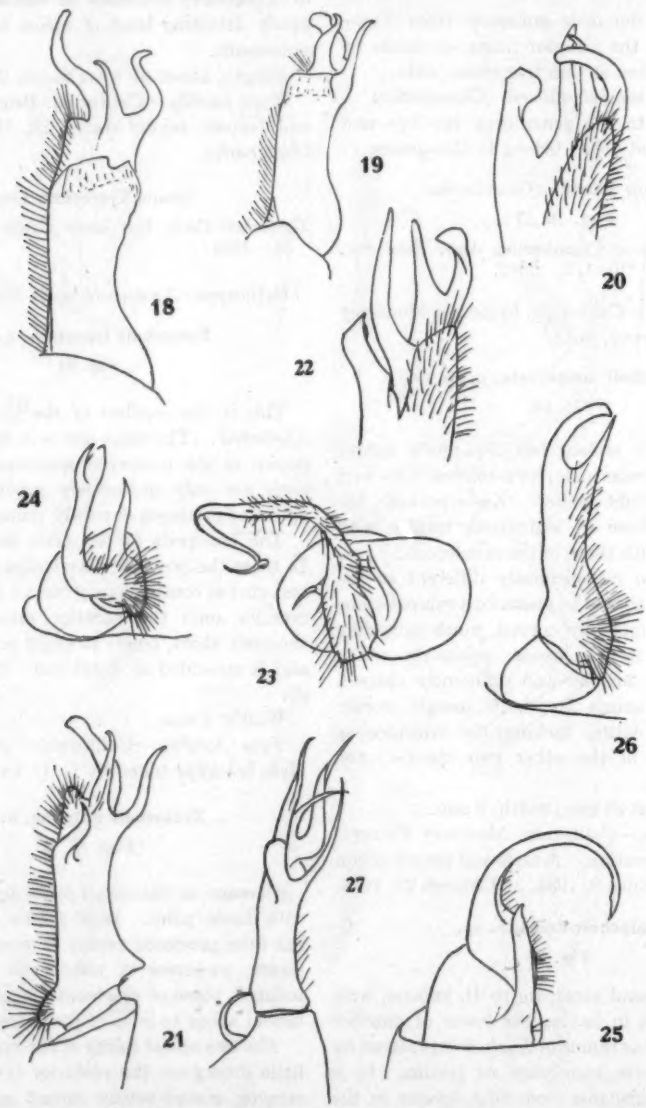
Dorsum of the usual light testaceous-brown with keels paler. Legs yellow. Lateral keels but little produced except on most posterior segments; processes of nineteenth segment much reduced, those of nineteenth large and extruding caudal about to level of the apices of the former.

The two apical spines of the male gonopod but little divergent, the posterior (ventral) of these curving conspicuously mesad and a little expanded at the distal end. The anterior ramus curving ectad, distally subtruncate, with distal corner of end produced. See further Figs. 21 and 22.

Length, 28–30 mm; width, 6.2–6.5 mm.

Type locality.—California: Scrub pine hills east of Milpitas. Four specimens taken February 1, 1928, by J. C. Chamberlin.

Differs from *X. dissecta* (Wood) in details of gonopods, e.g., in the anterior ramus, which is distally truncate with upper corner acutely produced instead of being distally rounded, etc.



FIGS. 18–27.—18, *Delocheir conservata*, n. sp., left gonopod, anterior aspect; 19, *Delochir dalea*, n. sp., left gonopod, anterior aspect; 20, *Xystocheir francisca*, n. sp., left gonopod, apical part of telopodite, mesal view; 21, *Xystocheir milpitas*, n. sp., right gonopod, anterior view; 22, *Xystocheir milpitas*, n. sp., left gonopods, distal part of telopodite, mesal view; 23, *Apheloria tortua*, n. sp., left gonopod, ventral view; 24, *Epeloria nannoides*, n. sp., right gonopod, ventral view; 25, *Phanoria philia*, n. sp., right gonopod, anterior view; 26, *Zinaria mima*, n. sp., gonopod, anterior view; 27, *Xystocheir tularea*, n. sp., right gonopod, anterior view.

Xystocheir tularea, n. sp.

Fig. 27

The types of this form are too much bleached out from long preservation to reveal the original coloration with certainty, but it appears to have been testaceous,

This species is obviously distinct from *dissecta* and other known species in the form of the gonopods, particularly in the character of the anterior spine. This is relatively unusually long and is distally slenderly acuminate while proximally laminate. Of the other spines, the two outer ones are erect and long, while the mesal one is shorter and curves strongly ectad. See further fig. 27.

Width, 6.8 mm.

Type locality.—California: Tulare County, Sugar Loaf Mountain at altitude 6,000 feet. Male and female taken in April 1930 by K. Dennen.

Genus **Apheloria** Chamberlin

Apheloria Chamberlin, Can. Ent. **53**: 232. 1921.

Apheloria asburna, n. sp.

Dorsum dark brown, in part chocolate-colored; a rather narrow but sharply defined band across caudal border of tergites, this expanding laterad and embracing entire keels; apical portion of cauda yellow; legs yellow and antennae brown.

Coxae of legs of posterior region conspicuously spined; spines of second joint large. Sternite not spined.

In form of telopodite of gonopods resembling *A. tigana* Chamberlin of North Carolina; but the blade narrower and the basal spine only moderately curved instead of being strongly uncate.

Width, 10 mm.

Locality.—Tennessee: 20 miles north of Nashville. One male taken July 17, 1933.

Apheloria tortua, n. sp.

Fig. 23

Tergites dark brown to black with a large yellow median area occupying the posterior two-thirds of length; keels yellow excepting the anteromesal corner. Cauda and legs yellow, antennae brown.

None of the coxae and sternites spined.

The male gonopods seem distinct in the form of the distal portion of the telopodite and of the basal spine as shown in Fig. 23.

Length, about 39 mm; width, 9 mm.

Type locality.—Virginia: Mountain Lake. One male taken by A. C. Cole in July 1942.

Genus **Epeloria** Chamberlin

Epeloria Chamberlin, Bull. Univ. Utah, biol. ser., **5** (3): 3. 1939.

Orthotype: *Epeloria talspoosa* Chamberlin.

Epeloria nannoides, n. sp.

Fig. 24

The type specimen, which is apparently not in full color, has the tergites light orange, with keels and a band across caudal border of each tergite yellow. Legs yellow.

The gonopods of the male are quite distinct from those of any previously described. See Fig. 24.

Width, 4 mm.

Type locality.—Florida: Gainesville. One male taken February 10, 1942.

Phanoria, n. gen.

Telopodite of male gonopod a simple apically acute blade curved in a semicircle; on anterior side of coxa a process in form of an erect blade, in this differing, for example, from *Sigmoria*.

Orthotype: *Phanoria philia*, n. sp.

Phanoria philia, n. sp.

Fig. 25

Dorsum dark brown, with a rather broad yellow band across caudal border of each tergite and its keels, the lateral borders of the latter and the cauda also yellow.

Posterior coxae bearing apically conical points or spines, but the sternites not spined.

Telopodite of male gonopod apically of hastate form. Anterior process from coxa a straight, apically acute blade. See further Fig. 25.

Width of male holotype, 9 mm.

Type locality.—Georgia: Clarkesville. One male taken April 27, 1943.

Genus **Zinaria** Chamberlin

Zinaria Chamberlin, Bull. Univ. Utah, biol. ser. **5** (3): 4. 1939.

Orthotype: *Zinaria cala* Chamberlin.

Zinaria mima, n. sp.

Fig. 26

Dorsum brown, in part chestnut; a narrow

yellow band along caudal margin of each tergite, this band somewhat expanded at middle, embracing caudal corner of keels and continued forward on lateral margin of keel in a narrow line, less broadly embracing keel than usual in *butleri*. Cauda yellow. Legs yellow.

In the gonopods the male differing from *butleri* in having the prongs of the telopodite more erect and distally less divergent as shown in Fig. 26.

Length of female allotype about 25 mm; width, 6 mm. Male holotype a little smaller.

Type locality.—Pennsylvania: Greene County. Two males and three females taken July 29, 1926, by T. L. Guyter.

Perhaps the northern representative of *Z. cala*, which it suggests in the position of the terminal prongs of the gonopods of male, but in *cala* these are more nearly parallel and thus much more widely divergent distally.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

424TH MEETING OF BOARD OF MANAGERS

The 424th meeting of the Board of Managers, held in the Cosmos Club, January 10, 1949, was called to order at 8:05 P.M. by the President, Dr. FREDERICK D. ROSSINI. Others present were: H. S. RAPPLEYE, N. R. SMITH, W. L. SCHMITT, W. W. DIEHL, F. M. DEFANDORF, W. RAMBERG, C. F. W. MUESEBECK, W. W. RUBEY, W. A. DAYTON, C. A. BETTS, M. A. MASON, L. A. ROGERS, O. B. FRENCH, C. L. GAZIN, and, by invitation, H. E. MCCOMB, R. J. SEEGER, ALAN STONE, F. C. KRACEK, L. V. JUDSON, F. H. H. ROBERTS, JR., and FRANK THONE.

The President announced that Ernest G. Holt, of the Soil Conservation Service, Department of Agriculture, had been delegated to represent the Academy at the Seventh Pacific Science Congress to be held in New Zealand during February 1949.

The Executive Committee met informally by telephone on January 10 and concurred in recommending to the Board of Managers that an additional $156 be allotted to the Secretary's office to cover expenses incurred in 1948 beyond the original $400 budget allotment.

The Board of Managers approved the additional sum for the 1948 expenses of the Secretary's office.

The chairman of the Committee on Meetings, Dr. R. J. SEEGER, discussed the problem of getting the membership out for the meetings. It was generally concluded that more emphasis should be put on joint meetings and that efforts should be made to get occasional meetings of more interest to engineering groups.

The chairman of the Committee on Membership, H. E. MCCOMB, presented three nominations for resident membership.

The chairman of the Committee on Monographs, Dr. L. V. JUDSON, announced that the monograph on *The Parasitic cuckoos of Africa* was in the process of being bound. The sum of $2,300 was cited as the final cost of printing the monograph, indicating a cost of $4.70 per copy necessary to secure a return of the investment on sale of one-half the issue. The committee recommended a figure of $4.50 as the price to be charged and the Board of Managers concurred.

C. F. W. MUESEBECK, acting for the chairman of the general Committee on Awards for Scientific Achievement in 1948, presented the following three recommendations for the Awards:

Biological Sciences: Dr. ROBERT J. HUEBNER, of the National Institutes of Health, in recognition of contributions to our knowledge of the transmission of certain rickettsial diseases.

Engineering Sciences: Dr. MAXWELL K. GOLDSTEIN, of the Office of Naval Research, in recognition of distinguished research and development in the field of electronic engineering.

Physical Sciences: Dr. J. A. VAN ALLEN, of the Applied Physics Laboratory of Johns Hopkins University, in recognition of his work in nuclear physics and cosmic rays.

The Board of Managers accepted the recommendation of the Committee on Awards for Scientific Achievement.

The chairman of the Committee on Grants-in-aid for Research, Dr. F. H. H. ROBERTS, JR., announced that the fund for grants-in-aid available from the A.A.A.S. would this year amount to about $325 and that applications for a grant from this fund are now receivable.

Capt. C. L. GARNER, having been retired from the gainful practice of his profession, was trans-

ferred to the retired list of members, effective December 31, 1948.

The Secretary announced the death of WILLIAM H. EMMONS, of the University of Minnesota, on November 5, 1948.

The Secretary also announced that with the concurrence of the Executive Committee and the chairman of the Meetings Committee, the Academy held a joint meeting with the Geological Society of Washington on January 3. Prof. HANS CLOOS, of the University of Bonn, spoke on *Geologic structures through the ages.*

The results of the ballot submitted to the membership in December proposing a new Article I for the By-laws (see minutes of the 420th meeting of the Board) were presented as follows:

In favor of the amendment	249
Opposed	3
Blank ballots	3
Ballots received	255

The Secretary informed the Board that he had received from Dr. W. N. FENTON, chairman of the Committee on the Index to the Journal, the contract for the work of indexing the Journal signed by Miss Mary Bradley and Dr. W. N. Fenton.

The Treasurer, H. S. RAPPLEYE, presented the names of two members who requested resignation because of retirement from their profession: CLYDE W. WARBURTON and ELMER D. MERRILL. A third member, WALTER F. STUTZ, requested transfer to life membership. Mr. RAPPLEYE called attention to the fact that these men had paid dues for 10 years and were eligible for retirement. The Board of Managers voted to place these names on the retired list of members, effective December 31, 1948.

The meeting was adjourned at 9:20 P. M.

C. LEWIS GAZIN, *Secretary.*

NEW MEMBERS OF THE ACADEMY

There follows a list of persons elected to membership in the Academy, by vote of its Board of Managers, since January 1, 1948, who have since qualified as members in accordance with the By-Laws. (See also previous list in May 15, 1948, issue of JOURNAL.) The bases for election are stated with the names of the new members.

RESIDENT

Elected January 12, 1948

NEIL W. STUART, botanist, Bureau of Plant Industry, Soils, and Agricultural Engineering, in recognition of his services and research in the field of nutrition, and effects of environmental factors on plant growth.

Elected April 12, 1948

DANIEL C. LEWIS, JR., mathematician, University of Maryland, in recognition of his contributions to the mathematical theory of dynamical systems and his work upon the four-color problem.

DICK WICK HALL, mathematician, University of Maryland, in recognition of his contributions to the field of topology.

L. MARTON, physicist, National Bureau of Standards, in recognition of his contributions to modern experimental physics, especially his pioneering role in the development of electron microscopy.

EDOUARD H. SIEGLER, entomologist, Bureau of Entomology and Plant Quarantine, in recognition of research in insecticides, particularly with reference to fruit insects.

LYMAN B. SMITH, botanist, U. S. National Museum, in recognition of his contributions to taxonomic botany, especially of the Bromeliaceae and Begoniaceae of Central and South America, and his outstanding work at the Gray Herbarium.

B. D. VAN EVERA, chemist, George Washington University, in recognition of his contribution to the war effort in World War II, his ability as an organizer of scientific projects, and his training of young men for professional careers in science.

Elected May 17, 1948

EDWARD W. BAKER, entomologist, Bureau of Entomology and Plant Quarantine, in recognition of his contributions to the classification of the Acarina (mites).

DONALD B. BROOKS, automotive engineer, National Bureau of Standards, in recognition of his important contributions in the field of automotive engineering, and in particlar for improvements in the precision of rating automotive engine fuels.

CLEDO BRUNETTI, electrical engineer, National Bureau of Standards, in recognition of his outstanding work in engineering electronics.

DEAN S. CARDER, geophysicist, U. S. Coast and Geodetic Survey, in recognition of his contributions to seismology, in particular "his research work on major crustal structure of the earth, the Pacific in particular, and the relation of reservoir loading to local earthquake activity," and his

observational work on vibrations of structures and other work on engineering seismology.

THOMAS J. CARROLL, physicist, National Bureau of Standards, in recognition of his work on Faraday effect of diatomic molecules; radio-wave propagation at microwave frequencies as applied to radar and relay communications.

ROBERT E. GEBHARDT, geophysicist, U. S. Coast and Geodetic Survey, in recognition of his contributions in instrumental geomagnetism and seismology with special reference to the development of the Induction Field Magnetometer and visible recording seismographs.

ROBERT D. HUNTOON, physicist, National Bureau of Standards, in recognition of his basic contributions to science of electronic ordnance, proximity fuze, stabilized missiles, etc.

J. W. JOYCE, geophysicist, Department of the Navy, in recognition of his work in geomagnetism, geophysical prospecting, and airborne electronic equipment.

RAYMOND MORGAN, physicist, University of Maryland, in recognition of his contributions to physics with particular reference to his work on X-ray and electron diffraction.

WALTER J. MURPHY, chemist, American Chemical Society, in recognition of his contributions to engineering chemistry.

HAROLD W. MURRAY, engineer, U. S. Coast and Geodetic Survey, in recognition of his special skills in the interpretation of hydrographic surveys and mapping of the ocean bottom.

PAUL H. OEHSER, science historian and editor, Smithsonian Institution, in recognition of his services to the sciences of natural history and to the history of science in Washington.

R. I. SAILER, entomologist, Bureau of Entomology and Plant Quarantine, in recognition of his contributions to the classification of the Hemiptera-Heteroptera.

LANSING G. SIMMONS, mathematician, U. S. Coast and Geodetic Survey, in recognition of his contributions to geodesy through his development of methods for computations of geographic positions, ultra precise geodetic surveys, and control surveys.

CHARLES B. WILLINGHAM, chemist, National Bureau of Standards, in recognition of his contributions to physical chemistry particularly as applied to fractionation of hydrocarbons in petroleum.

Elected June 7, 1948

EVELYN ANDERSON, endocrinologist, National Institutes of Health, in recognition of her contributions to the study of the endocrine glands.

JOSEPH M. CALDWELL, electrical engineer, Beach Erosion Board, in recognition of his contributions to the science of hydraulics, particularly in the development of hydraulic model studies.

DORLAND J. DAVIS, surgeon, U. S. Public Health Service, in recognition of his contributions to research on psittacosis.

KENNETH M. ENDICOTT, surgeon, National Institutes of Health, in recognition of his contributions to pathology and toxicology of chemotherapeutic compounds.

KARL HABEL, surgeon, National Institutes of Health, in recognition of his researches on rabies and mumps.

JOHN A. HIPPLE, physicist, National Bureau of Standards, in recognition of his contributions to research in the field of mass spectrometry and electronics including important developments in instrument design and in molecular physics.

GEORGE A. HOTTLE, biochemist, National Institutes of Health, in recognition of his contribution to the application of chemical principles to biological problems.

ROBERT J. HUEBNER, assistant surgeon, National Institutes of Health, in recognition of his contribution to the investigation and identification of a new disease (rickettsialpox) with identification of the animal reservoir and the transmitting mite, and for his studies of Q fever and the demonstration of the presence of Q fever rickettsia in milk from cattle in the Los Angeles area.

JAMES M. HUNDLEY, medical research, National Institutes of Health, in recognition of his contributions to nutrition research, especially the relationships of vitamins and amino acids.

ERNEST L. JACKSON, chemist, National Institutes of Health, in recognition of his contributions to organic chemistry and chemotherapy.

KENNETH L. KNIGHT, entomologist, Naval Medical Center, in recognition of his studies on the mosquitoes of the Pacific and Oriental regions, particularly of the genus *Aedes* and *Anopheles*.

R. D. LILLIE, pathologist, National Institutes of Health, in recognition of his studies on gross and histological pathology of infectious diseases,

and toxicological pathology of organic compounds.

GORDON W. MCBRIDE, chemist, U. S. Department of Agriculture, in recognition of researches in continuous process for soap, and other researches in chemical engineering.

PAUL A. NEAL, biologist, National Institutes of Health, in recognition of his work in industrial hygiene and toxicology.

BYRON J. OLSON, surgeon, National Institutes of Health, in recognition of his fundamental researches on tuberculosis and histoplasmosis.

JOHN H. PARK, physicist, National Bureau of Standards, in recognition of his work on electrical surges in particular in the field of measurement of transient surge currents of large magnitude.

SAMUEL B. SALVIN, botanist, National Institutes of Health, in recognition of his researches in mycology.

ARNOLD H. SCOTT, physicist, National Bureau of Standards, in recognition of his work on the density and electrical properties of rubber.

HEINZ SPECHT, physiologist, National Institutes of Health, in recognition of his research in physiology of respiration.

ROBERT M. STEPHAN, dental surgeon, National Institutes of Health, in recognition of dental research and research on biochemical mechanism by which tooth substance is destroyed in dental caries.

HERBERT TABOR, surgeon, National Institutes of Health, in recognition of his studies on shock and vitamins.

FLETCHER P. VEITCH, JR., biochemist, University of Maryland, in recognition of his contributions in biochemistry, and in particular his work on estrone.

W. F. VON OETTINGEN, toxicologist, National Institutes of Health, in recognition of his research in toxicology.

G. FORREST WOODS, chemist, University of Maryland, in recognition of his researches in organic chemistry, and in particular his work on the chemistry of hexatriene.

Elected October 18, 1948

NORMAN F. BRAATEN, mathematician, U. S. Coast and Geodetic Survey, in recognition of his work in the processing and interpretation of geodetic-survey records and in particular for his development of the circuit-reduction method of the adjustment of leveling networks.

VICTOR H. CAHALANE, biologist, National Park Service, in recognition of his contributions to mammalogy and to wildlife conservation and management.

NONRESIDENT

Elected May 17, 1948

CHARLES A. THOMAS, chemist, Monsanto Chemical Co., St. Louis, Mo., in recognition of his work in development of tetraethyl lead, synthetic rubber, rocket propellants, chemistry of plutonium, etc.

Elected October 18, 1948

ALEXANDER SILVERMAN, chemist, University of Pittsburgh, Pittsburgh, Pa., in recognition of outstanding service as a teacher of chemistry and his contributions to the chemistry and technology of glass.

HONORARY

Elected May 17, 1948

ALBERT K. FISHER, zoologist (deceased since election), formerly of U. S. Department of Agriculture, in recognition of his distinguished service in ornithology and mammalogy.

GEOLOGICAL SOCIETY[1]

646TH MEETING

The 646th meeting of the Society was held at the Cosmos Club, January 18, 1947, President W. P. WOODRING presiding. A memorial to Dr. GERALD F. LOUGHLIN was read by L. W. CURRIER.

New business.—The amendment to Article III, "Dues," of the Standing Rules was approved by the members.

Program.—HUGH D. MISER: *Petroleum geology in the United States Geological Survey.*

G. EDWARD LEWIS: *El Sangay, and some other volcanoes of Ecuador.** An expedition to the least known of the world's great active volcanoes has resulted in the preparation of the first sketch map showing possible routes of approach to El Sangay. New data on El Sangay's activity were secured, together with a photographic record of this and other volcanoes of Ecuador.

WILLIAM F. GUYTON: *Industrial use of ground water in the United States.** Data compiled by the U. S. Geological Survey and by several State

[1] Those abstracts marked with an asterisk* have been approved for publication by the Director of the U. S. Geological Survey.

agencies[2] justify an estimate that the withdrawals of ground water in the United States in 1945 were about as follows:

Class of use	1945 (Million gal./day)
Irrigation	10,000
Industrial, not including water supplied from municipal systems	5,000
Municipal	3,000
Rural, not including irrigation	2,000
Total	20,000

The use of ground water has been increasing at a rapid rate. This has been due partly to increased production and unusual demands caused by the war, and partly to improved methods of locating, developing, and maintaining ground-water supplies.

The most rapid increase, by percentage, has been for industrial purposes. Ground water is preferred to surface water by many types of industries, especially where the demands are small to moderate. The principal reasons for this preference are ground water's availability, its freedom from bacterial and suspended matter, and its uniform temperature, which is generally lower than that of surface water during summer months.

Large quantities of ground water are pumped from small areas in many parts of the United States. Following is a table showing the total quantities of water withdrawn in 1945 in the 10 areas of largest concentrated withdrawal, together with the amounts withdrawn from private wells exclusively for industrial use.

Area	Total withdrawal	Industrial withdrawal
	(Million gallons a day)	
1. South Coastal Basin, Calif.	400 ±	40 +
2. Long Island, N. Y.	280	90 ±
3. Houston-Baytown-Galveston Co.-Katy, Tex.	218	115 ±
4. Memphis, Tenn.	105	74
5. San Antonio, Tex.	100	15
6. East St. Louis, Ill.	89	85
7. Peoria-Pekin, Ill.	86	67
8. Chicago, Ill.	84	48
9. Dayton, Ohio	73	40
10. Cincinnati-Mill Creek Area, Ohio	69	67

[2] The Illinois State Water Survey furnished nearly all the data for Illinois.

In 19 areas[3] where pumpage inventories have been made (mostly in 1945), the total amounts of ground water withdrawn by various types of industry were as follows:

Type of industry	Withdrawal (Million gal./day)	Number of cities represented
1. Oil refining	71	8
2. Metal working	57	10
3. Paper manufacturing	51	4
4. Chemical manufacturing	50	5
5. Distilling	47	3
6. Rubber manufacturing	40	3
7. Buildings, air conditioning, refrigerating	40	13
8. Food processing	35	9
9. Ice making and cold storage	32	11
10. Meat packing	32	9
11. Brewing	20	6
12. Railroads	17	10
13. Dairying	13	7

Other important uses include requirements of gas and electrical plants, aircraft plants, ordnance plants, resinous products manufacturing, and mines.

Because of the rapid expansion in development of ground water, numerous problems have arisen which occasionally have caused people to think there is a general shortage of ground water in the United States. This is far from the truth. On the contrary, the ground-water future of the United States is very bright indeed. The trouble spots will gradually be eliminated by proper distribution of wells, legal control, and the like; and there are tremendous untouched reserves and possibilities for increasing existing supplies. Modern knowledge and methods will assure successful and economical development of these supplies. For—what most people do not realize—the actual results of scientific ground-water investigations today make the most exaggerated claims of water witches sound like child's play!

[3] Chosen at random, and not necessarily areas of largest withdrawal. Louisville, Ky.; Houston-Baytown-Texas City, Tex.; Philadelphia, Pa.; Pittsburgh, Pa., 80 per cent; El Dorado, Ark.; Benton Harbor, Mich.; Akron, Ohio; Kansas City, Kan.; Chillicothe, Ohio; South Bend, Ind.; Miami, Fla.; Jacksonville, Fla.; Pensacola, Fla.; Okla. City, Okla.; Peoria-Pekin, Ill.; East St. Louis, Ill.; Chicago, Ill.; Minneapolis-St. Paul, Minn.; Milwaukee, Wis., 65 per cent.

647TH MEETING

The 647th meeting of the Society was held at the Cosmos Club, January 22, 1947, Vice-President ERNST CLOOS presiding.

Informal communication.—ROBERT CHAPMAN presented some observations on Aufeis in Alaska.

Program.—R. S. ALLAN: *Origin, distribution, and ecology of Tertiary brachiopods of the Southern Hemisphere.*

MARCUS I. GOLDMAN: *Bauxitization—a tropical disease.** In a recent paper in Economic Geology, Goldman and Tracey pointed out that there is, in the bauxitized nepheline syenite of Arkansas, abundant evidence of kaolinization of bauxite but no evidence known to them of bauxitization of kaolin, and that the kaolin occurring between fresh and bauxitized nepheline syenite is dense and structureless whereas the bauxitized nepheline syenite retains the texture of the fresh nepheline syenite. They therefore suggested that the bauxite has been formed directly from the nepheline syenite, not from kaolinized nepheline syenite. Among the evidences of kaolinization are patches of kaolin, in bauxitized nepheline syenite, enclosing pseudo-fragmental remnants of the bauxite. The occurrence of such patches adjacent to unbauxitized cores of nepheline syenite in process of kaolinization is regarded as evidence that silica escaping from the kaolinizing cores resilicated (kaolinized) the adjacent bauxite. This, the speaker suggested, is almost conclusive evidence that kaolin was not an intermediate stage in the bauxitization of the nepheline syenite as rekaolinization of any bauxite assumed to have formed around a kaolinizing core would prevent the formation of bodies of bauxite, such as now exist in Arkansas, outside such cores.

Citing previously expressed opinions that the difference between conditions favoring kaolinization and those favoring bauxitization could not be attributed to mere difference in climatic factors but probably involved the participation of microorganisms, the speaker made the point that it is particularly difficult to conceive of two climates so different that one would permit silica to pass through bauxite without combining with it, whereas the other would permit it to combine to form kaolin.

In support of the belief that some specific factor such as the activity of an organism caused bauxitization and prevented silica passing through bauxite from combining with it, the speaker described a bauxitized boulder of nepheline-syenite, from one of the bauxite mines in Arkansas, discovered and studied by Fred A. Hildebrand, which consisted essentially of the following three concentrically arranged portions: An outer envelope of high-grade bauxite with granitic texture, an inner core of less pure bauxite with granitic texture, and between the two a dense structureless layer of kaolin. These puzzling relationships were explained on the assumption that they recorded the ending of the conditions permitting bauxitization. Those silica-bearing waters moving out from the inner core that were in the outer part of the boulder escaped before bauxitization ended. But those in the kaolinized layer were caught there as bauxitizing conditions came to an end and therefore recombined with the enclosing bauxite to from kaolin.

The speaker questioned the opinion expressed by Holland in 1903 that kaolinization and bauxitization could not coexist and pointed out that to the best of his knowledge most of the bauxitized nepheline syenite of Arkansas contained some silica assumed to be combined as kaolin, and that the variation in the gibbsite-kaolin ratio with depth in the Arkansas deposits of transported beauxite indicates a progressive increase and decline in the ratio of gibbsite to kaolin with time during the period of bauxite formation.

ROBERT F. BLACK and WILLIAM L. BARKSDALE: *Oriented lakes of northern Alaska.** The oriented lakes of northern Alaska occur in an area of more than 25,000 square miles in the Arctic Coastal Plain province. The topography, drainage, vegetation, climate, geology, and permafrost of the area are briefly described. The average range of orientation of the lakes is 13°—from N. 9° W. to N. 22° W. In any one locality the deviation from the average is commonly less than 3° and rarely over 5°. The lakes range in size from small ponds, a few tens of feet in length, to large lakes more than 9 miles long and 3 miles wide. The shapes may be described as elliptical, cigar-shaped, rectangular, ovoid, triangular, irregular, or compound. One group of lakes has a shallow shelf or under-water bench surrounding a deeper central portion. The rest are shallow throughout and the under-water profile is commonly concave upward. The major outline of the lakes is smoothly curved but in detail it is cuspate or jagged. No lacustrine

beach ridges were recognized. Former lake basins, now drained, and extensions of the present lakes are indicated by shore features, lacustrine deposits, the character of polygonal ground, and vegetation. The effects of wind, vegetation, and permafrost are briefly described. The lakes are compared with the Carolina Bays and rectangular lakes in eastern U.S.S.R. Many of the lakes are believed to be the result of thawing of permafrost; others may be produced by the segmentation of uplifted lagoons. The origin of some is not known.

648TH MEETING

The 648th meeting of the Society was held at the Cosmos Club, February 12, Vice-president CARLE H. DANE presiding.

Informal communication.—Ralph L. Miller described some oolites he collected near Allentown, Pa.

Program.—HARRY H. HESS: *Major structures of the Western Pacific indicated by the bathymetric chart, Korea to New Guinea, H. O. No. 5485.*

EARL INGERSON: *Hydrothermal mineral synthesis.*

J. D. STROBELL, JR.: *Multiplex compilation of geologic maps from aerial photographs.*

649TH MEETING

The 649th meeting of the Society was held at the Cosmos Club, February 26, 1947, Vice-president CARLE H. DANE presiding.

Informal communication.—GERALD FITZGERALD.

Program.—C. E. JACOB: *Elasticity of artesian aquifers.*

T. G. PAINE: *Tectonic control of sediments during a diastrophic cycle.*

Prof. KARL MANNERFELDT: *Deglaciation of the Scandinavian Mountains.*

650TH MEETING

The 650th meeting of the Society was held at the Cosmos Club, March 12, 1947, president W. P. WOODRING, presiding.

Informal communications.—F. N. JOHNSON spoke on stream capture and WATSON MONROE discussed the weathering of glauconite.

Program.—A. P. BUTLER: *Transition from Tertiary volcanic activity to basin filling in north-central New Mexico.*

H. YAGODA: *Radiochemical techniques in the study of fine-grained radio-active minerals.*

G. A. COOPER: *The decline of paleontology.*

651ST MEETING

The 651st meeting of the Society was held at the Cosmos Club, March 26, 1947, Vice-president CARLE H. DANE presiding.

Informal communication.—C. E. JACOB spoke on the use of ground water for air-conditioning.

Program.—L. W. CURRIER: *Applied geology in the Massachusetts program.*

M. D. FOSTER: *Origin of high sodium bicarbonate water in the Coastal Plain.*

ERNEST DOBROVOLNY: *Geology applied to highway design and construction.** Geology as a phase of investigation necessary to economic road construction was recognized by the State Highway Commission of Kansas about 1935 when geological information was used in designing more satisfactory bridge footings. Refinement in the collection and presentation of methods indicated that geological data were amenable to mathematical evaluation accurately enough for the measurements required in highway engineering. This concept led to the development of a system of classification for excavation based essentially on lithology. The classification, now incorporated in the standard road specification, reads in part, "... common excavation shall consist of the removal and satisfactory disposal of all eolian, alluvial and residual materials and certain designated strata ..."; "... rock excavation shall include all firm, unaltered and unweathered cherty limestone, shaly limestone, sandy limestone, earthy and impure limestone and all other limestones including chalk beds and gypsum beds; all firm, unweathered and unaltered argillaceous, arenaceous, calcareous and carbonaceous shale, sandstone, cemented conglomerates and mortar beds ...."

Close association of engineers and geologists brought up questions in the field of geology which could not be answered because the necessary research had not yet been done. One outgrowth of these questions is sponsored research on problems involving kaolin minerals, mantle seepage, and construction materials.

652D MEETING

The 652d meeting of the Society was held at the Cosmos Club, April 9, 1947, Vice-president CARLE H. DANE presiding.

Informal communications.—E. F. INGERSON spoke on the use of liquid inclusions in geologic

thermometry and R. R. COATES described boulders that he studied on the Aleutian Islands.

Program.—R. P. FISCHER: *Origin of the Colorado Plateau vanadium deposits.** The vanadium deposits of the Colorado Plateau occur in sandstone beds of Mesozoic age. Most of them are restricted to a few stratigraphic horizons, along which they have a wide but spotty areal distribution. All the deposits have many common characteristics.

The ore minerals mainly impregnate sandstone, partly or completely filling the pore spaces of the rock. The ore bodies are irregularly shaped in plan and in section they form tabular or lenticular layers that lie nearly parallel to the bedding. These layers do not follow the beds in detail, however, and for this reason the ore in its present form can not be syngenetic but rather had to have been precipitated from solutions after the sands had accumulated.

Though the geologic environment of the vanadium deposits differs somewhat from place to place, no definite relationship has yet been demonstrated between the spatial distribution or the character of the deposits and geologic structures such as faults, folds, and igneous intrusions. Considering all factors it is difficult to rationalize the localization and character of the deposits as originating from hydrothermal or ground-water solutions that might have been introduced into the ore-bearing beds along through-going, vertical structures resulting from regional deformation or igneous activity.

Nevertheless, the habits of the ore and the location of the deposits show a close relationship to sedimentary structures and conditions that would certainly influence at one time or another the flow of solutions along or through the ore-bearing beds. Recognizing these features, and believing that mineralization after regional deformation is unlikely, it is therefore suggested that the vanadium ore was precipitated from ground waters moving along the beds during a period of active circulation shortly after the sands accumulated. Precipitation probably was caused by relatively slight changes in composition of the waters, resulting from reactions in an environment of decaying organic matter, reactions at a water table, or the mixing of two solutions.

PAUL D. KRYNINE: *Diastrophism and the origin of sediments.*

653D MEETING

The 653d meeting of the Society was held at the Cosmos Club, April 23, 1947, President W. P. WOODRING presiding. The death of C. DWIGHT AVERY, a member of the Society, was announced.

Program.—E. N. GODDARD: *A new rock color chart for field use.*

F. S. SIMONS: *Structure and recent activity of the Great Sitkin Volcano.*

V. P. SOKOLOFF: *Engineering map units in Fairfax quadrangle, Virginia.**

Introduction. The basis of this discussion is a report entitled "Engineering Soil Map of Fairfax Quadrangle, Virginia." The report was transmitted by the U. S. Geological Survey to the Public Roads Administration for analysis and criticism. The work was done in 1946 in the Engineering Geology Section of the Survey.

Problem. A major purpose of the investigation was to find out whether a usefully accurate engineering map could be produced in the office, given the required basic data. If so, reliability of the methods developed by a group of soil scientists in wartime, for the Military Geology Unit of the Survey would be attested further. A cheap and a rapid method of terrain appraisal would be then indicated, for areas having agronomic, aerial photograph, and areal geologic coverage. It was also desired to test a hypothesis that an engineering soil map of the entire area is more useful and more economic, in road building, than a series of strip maps along proposed highway locations.

The degree of attainment of these objectives will be ascertained by testers and users of the map.

Engineering map unit. The need for a somewhat nongeologic, nonagronomic map unit became apparent gradually, in the course of the present study. The concept of the engineering map unit was evolved in order to minimize the unavoidable wide range of variation in engineering properties within the geologic and the agronomic map units. It became necessary, in places, to break some geologic map units into several engineering map units. In other places, parts of several geologic (and agronomic) units had to be combined into a single engineering map unit.

The necessity for such reorganization of the basic data is illustrated by the accompanying lantern slides. A brief statement of the procedure may be of additional use in this connection.

Procedure. (1) A detailed study of land surface and drainage of the area. (2) Recognition of probability of periodic or seasonal floods in certain stream bottoms. This single consideration is believed to outweigh any other feature of such areas (texture and depth of soil, kind of bedrock, etc.). Recognition of such areas as one single engineering map unit. (3) Recognition of general physiographic features (Basin and Upland). Recognition of the probability that construction problems, soil materials, and regolith in general are not the same in the Basin as in the Upland. Separation of Basin from Upland on the engineering map. (4) Preparation of vegetation map, from the aerial photographs, in aid to a more detailed study of the quadrangle. (5) Recognition of excessively steep slope as a possible definitive feature, in certain areas, regardless of other variables (kind of bedrock, kind of soil, etc.). Slope analysis map, in aid to further study of the quadrangle. (6) Study of the areal geologic map, in conjunction with the agronomic soil map, especially in regard to possible presence of rock suited for construction and of granular construction materials. Presence of accessible hard rock noted, in some geologic map units. (7) Conclusion that the following variables merit separate consideration, in establishing and describing engineering map units in the Quadrangle: (*a*) Bedrock, as interpreted from the geologic map. (*b*) Drainage, as interpreted from the aerial photographs. (*c*) Slope, as interpreted from the slope analysis map. (*d*) Thickness of regolith, as surmised, locally, from the agronomic soil map and as derived from the general knowledge of probable depth and kind of weathering of a known kind of rock in a known kind of environment. (*e*) Sequence, texture, and physical properties of different horizons of the regolith, with a special interest in the probable presence or absence of plastic horizons, as interpreted from (*a*), (*b*), (*c*), (*d*), in the light of general knowledge of the soil-forming processes. (8) Preparation of the engineering soil map.

Conclusion. The concept of the engineering map unit, as developed in the Fairfax study, has contributed to conciseness and readability of the engineering map. The nature and usefulness of such concept, however, are not the same in different types of terrain. Further studies should be indicated, to determine the value of engineering mapping of the Fairfax type. In any case, however, it seems advantageous to depart occasionally from the purely agronomic or purely geologic approaches to engineering geologic mapping.

654TH MEETING

The 654th meeting of the Society was held at the Cosmos Club October 22, 1947, President W. P. WOODRING, presiding.

Program.—C. H. BEHRE, JR.: *Structural control of the European lead-zinc deposits of the "Mississippi Valley" type.* The purpose of this paper is to describe the geological features generally typical of "Mississippi Valley" type lead-zinc ores, with special reference to the structures that seem to have localized these ores. The paper is a greatly condensed statement of certain conclusions resulting from nine months of European study in 1937–38 while its author held a John Simon Guggenheim Memorial Fellowship. Despite the danger that generalizations too broad to be accurate may result, the general overview of any distinct type of ore deposit seems justifiable because it promises eventually to shed light on the genesis of these ores and to afford better guides for exploration than hitherto available.

Furnishing between a third and a half of the world's production of lead and zinc, the "Mississippi Valley" type is a distinguishable group of ore deposits recognized since the days of Von Cotta (1859) and Von Groddeck (1879). Their primary mineralogy is the especially characteristic criterion by which they are distinguishable: galena, sphalerite, pyrite, marcasite, calcite, and dolomite, frequently with noteworthy amounts of other carbonates, chalcopyrite, quartz, barite, and fluorite and with or without silver values. Their generally low silver content, their relative richness in lead and (or) zinc and leanness in copper, and the preponderance of carbonates as opposed to quartz gangue are especially typical. In general, the successive deposition is: calcite (usually in rhombohedral forms), pyrite (the oldest but recurrent metallic mineral), sphalerite, galena, marcasite, and late calcite (rhombohedral or scalenohedral). In many instances (Aachen, Moresnet, Silesia, Bleiberg) colloform features are

prominent, and elsewhere they can be found if sought (e.g., Sardinia, Wisconsin). There is no clear evidence here that these minerals are supergene, and the chemistry of their paragenesis favors hypogene solutions.

It is in their relation to geologic structures, however, that deposits of this type show the most marked variation. Their numerousness and wide distribution in Europe make that a peculiarly favorable continent for their study, and the governing structures highly varied: Derbyshire, north England, the Midi (France), Santander, Aachen-Moresnet, the Eifel-southern Rhine, Silesia, Sardinia, Raibl (Cave di Predil), Bleiberg, Mezica, and Laurion are all well-described examples. In general, these structures are characteristic controls: (1) Relatively flat-lying beds with a few faults, usually gently dipping, zigzag in vertical section, small in displacement, and related to bedding plane movements (e.g, Silesia, north England, and our own Wisconsin-Illinois district); (2) steeply folded beds with or without transverse faults (e.g., Sardinia, Aachen-Moresnet); (3) small or large tear faults (strike-slip faults, generally transverse to the regional strike and "grain"), often associated with close folding and thrusting (Laurion (?), Bleiberg, Mezica). Normal dip-slip faults, so common with gold and copper deposits, were major ore solution channels rarely if at all, a contrast not yet explained.

The general picture is that these deposits were formed (1) at shallow depths, (2) at cool temperatures (100°C. or less), (3) from solutions that travelled noteworthy distances laterally as well as vertically, (4) where the "acid" solutions were neutralized by calcareous country rock or neutralized and cooled by descending lime-carbonate waters at ground-water level.

SAMUEL ZERFOSS: *Some observations concerning the mechanism of crystallization.*

655TH MEETING

The 655th meeting of the Society was held at the Cosmos Club November 12, 1947, President W. P. WOODRING presiding. A memorial to Dr. GEORGE R. MANSFIELD was read by R. RICHARDS. Dr. W. D. JOHNSTON, JR., presented to the Society Dr. RICHARDO MONGES LOPEZ and Dr. JENARO GONZALEZ R., of the Instituto Geológico de México, and Dr. REYNALDO SALDAHA DE GAMA, of the Universidade de São Paulo, Brazil.

Program.—J. R. BALSLEY: *Use of the airborne magnetometer.*

C. S. ROSS: *Soil subsidence in Mexico City and its relation to failures of buildings.*

J. I. TRACEY, JR.: *Surface and subsurface structures of the Bikini reef.*

656TH MEETING

The 656th meeting of the Society was held at the Cosmos Club, November 26, 1947, President W. P. WOODRING presiding.

Program.—C. P. ROSS: *The Belt problem.** The present study of the problem of the Belt series in Montana is a byproduct of compilation of a proposed new geologic map of the State. The series is generally regarded as of pre-Cambrian age, although a few geologists have considered it Paleozoic and there is some reason to believe that its uppermost strata may have been laid down at the same time as fossiliferous Lower Cambrian deposits in other regions. The series is thought by most geologists to have been deposited in and on the margins of a shallow epeiric sea, possibly 500 miles wide, 2,000 miles long, and connected with the Arctic Ocean.

It is here proposed to include the lower part of the Belt series in the Ravalli group, with the exception of the Prichard formation and the Neihart quartzite, the middle portion in the Piegan group, and the upper part in the Missoula group. The Prichard formation and Neihart quartzite are older than the Ravalli, and the interrelations of these two formations are unknown. All of the above names are already in use, but the definitions of them given below constitute modifications of previous usage. The name North Boulder group is here proposed for certain hitherto unnamed components of the Belt series in isolated exposures near the Jefferson River, southeast of Butte. The relations between this group and the units farther north are not clear. In addition, the Belt units along the southwestern border of the State differ in details from those farther north and in part cannot be definitely correlated at present with any of the named subdivisions of the series. Large areas in Montana that are underlain mainly by rocks of the Belt series have been studied as yet only in reconnaissance fashion. Hence the nomenclature outlined in the present paragraph, and some of the correlations suggested below are to be regarded as provisional, pending more thorough studies.

The Neihart quartzite is positively known only in its type locality near Neihart, Mont., although the name has also been applied to strata that underlie the Prichard in the Anaconda Range. At its type locality the Neihart rests on gneiss and is overlain by the Chamberlain shale. The Prichard formation, first recognized in the Coeur d'Alene region in Idaho, is exposed at intervals from the northwest corner of Montana to the vicinity of Philipsburg. In most places it consists of metamorphosed argillaceous rock with some quartzite.

The term Ravalli group is here used to include those formations of the Belt series, that overlie or are believed to overlie the Neihart and Prichard formations, and are below the Newland limestone of the Piegan group or its stratigraphic equivalent. The name Ravalli was first used by Walcott and was raised to group rank by Calkins.[4] In and near Lincoln, Mineral, and Sanders Counties, Mont., the Ravalli group contains the Burke formation, Revett quartzite, and St. Regis formation, and ranges from white quartzite to siliceous shale, mostly in subdued tones of gray, green, purple, and red. In the extreme northwestern part of Montana the maximum thickness may be 10,000 feet. In and south of Glacier National Park the Ravalli group contains the Altyn limestone, Appekunny argillite, and Grinnell argillite with an aggregate maximum thickness of more than 12,000 feet. In the park the group includes dolomite and related rocks as well as gray, green and red argillite and quartzite. In the region south of Missoula the rocks of the Ravalli are predominantly light to dark-gray quartzite and argillite. In the Little Belt Mountains the Chamberlain shale (1,500 feet thick) is at present regarded as the sole unit that can be correlated with the Ravalli group.

Above the Ravalli group is the Piegan group in which carbonate-bearing rocks predominate. The Fentons,[5] who originated the name Piegan group, would place the upper boundary of the group at the top of the Shepard formation, but it seems preferable to follow Clapp and Deiss[6] in placing it at the bottom of the Shepard, thus including that formation in the overlying Missoula group. Where the Helena limestone is recognizable, which at present is only in the general vicinity of Helena, it is regarded as the upper formation of the Piegan group. The Greyson, Spokane, and Empire shales (named in ascending order), which overlie the Newland limestone and underlie the Helena in the Helena region, may be local units or may correspond to argillaceous rocks in other regions. The term Spokane has been applied to various units outside the Helena region by different geologists, but on the basis of present knowledge all these uses of the name seem so insecure as to be inadvisable.

The principal component of the Piegan group has been variously called Siyeh, Newland, and Wallace limestone or formation and these names are retained locally. In and near the Coeur d'Alene region in Idaho and Montana the Wallace formation, which in that region is the only representative of the Piegan group, is of diverse composition. It includes more or less calcareous shale and sandstone and impure, generally dolomitic limestone. It is distinctive in that it contains the only significant amounts of calcareous and dolomitic material in the Belt series of that region and most of the formation shows closely spaced banding. It also contains characteristic segregation structures. There is reason to believe that locally the formation, which is 17,000 feet thick near Libby, Mont., will eventually be subdivided into smaller map units. From the northwestern border of the State to the vicinity of Philipsburg the rocks of the Piegan group are similar to those just described, except that the carbonate content probably increases southeastward. In Glacier Park the Piegan group, as here defined, consists largely of massive dolomite and dolomitic limestone with interbedded argillite, quartzite, oolite, and mud breccia; maximum reported thickness is 5,400 feet. The carbonate rocks are banded in a manner similar to that of the Wallace and segretation structures and algal remains are present. Numerous subdivisions of the group in this area have been suggested. In the general

[4] CALKINS, F. C., *A geological reconnaissance in northern Idaho and northwestern Montana*. U. S. Geol. Survey Bull. 784: 38. 1909.

[5] FENTON, C. A., and FENTON, M. A., *Belt series of the North: Stratigraphy, sedimentation, paleontology*. Bull. Geol. Soc. Amer. **48**: 1890–1900. 1937.

[6] CLAPP, C. H., and DEISS, C. F., *Correlations of Montana Algonkian formations*. Bull. Geol. Soc. Amer. **42**: chart and p. 691. 1931.

vicinity of Helena, including the Belt Mountains, the Newland limestone, which constitutes the lower part of the Piegan group there, is an argillaceous, dolomitic limestone with some calcareous argillite. Segregation structures are not conspicuous. Above the Newland are three formations composed of gray, brown, red, and green shale, followed upward by the Helena limestone, an impure, fine-grained, in part dolomitic limestone with plentiful algal remains and segregation structures.

The Missoula group includes all of the Belt series above the Piegan group in all localities where the Piegan is recognizable. In southwestern Montana some of the Belt rocks lithologically resemble the Missoula but correlation on the basis of present data is speculative. In northwestern Montana and adjacent parts of Idaho the Missoula group is represented by the Striped Peak and Libby[7] formations. In and near Glacier Park the Shepard, Kintla, and other units[8] are included in it. In the vicinity of Missoula, its type locality, the group is described as containing 18,000 feet divided into five formations.[9, 10] In parts of the region around Helena the Marsh shale is the sole representative, but to the north other units appear and in the Saypo quadrangle four formations have been distinguished within the group.[11] In general, the Missoula group consists of argillaceous and siliceous clastic rocks, with subordinate calcareous beds. The prevailing color is red to purple, but green beds are present in most exposures and gray rocks are locally plentiful.

Strata of the Belt series here named the North Boulder group extend eastward along and north of the Jefferson River from the vicinity of North Boulder River, from which the name for the group is taken, to a point northeast of Sappington. The group is thought to rest directly on the pre-Belt complex of metamorphic rocks and lies without angular discordance beneath the Flathead quartzite (Middle Cambrian). Direct evidence concerning the age equivalence of the group is lacking. It may be equivalent in age to some part of the Missoula group or to part of that group and part of the Piegan group. The North Boulder group has coarse conglomerate at the base, with arkose, some conglomerate, and sandy and silty strata above. The total thickness is 6,000 feet or more. Subdivisions have not been shown on any published map but available information[12, 13, 14, 15] suggests that there are three or, more probably, four subdivisions of formational rank in this group.

JOSIAH BRIDGE: *Geology of the Palau Islands.*

T. STADNICHENKO: *Browsing through Russian literature on geology and allied science.*

657TH MEETING

The 657th meeting of the Society was held at the Cosmos Club, December 10, 1947, Vice-president CARLE H. DANE presiding.

The President announced that last January he had appointed a committee consisting of T. B. NOLAN, MARCUS GOLDMAN, and H. S. LADD to select the two best papers presented before the Society during 1947. Dr. Nolan was then called on to present the prizes. The first prize of $25 was unanimously awarded to C. E. JACOBS; the second prize of $10 was awarded to FRANK S. SIMMONS.

Program. Presidential address by WENDELL P. WOODRING: *Central America land bridge and sea lane.*

55TH ANNUAL MEETING

The 55th Annual Meeting was held immediately following the 657th regular meeting. The reports of the Secretaries, Treasurer, and Audit-

[7] GIBSON, RUSSELL, *Geology and ore deposits of Libby Quadrangle, Montana.* Bull. U. S. Geol. Survey in prep. 1947.

[8] FENTON, C. A., and FENTON, M. A., *Belt series of the North: Stratigraphy sedimentation, paleontology.* Bull. Geol. Soc. Amer. **48:** 1890–1900. 1937.

[9] CLAPP, C. H., and DEISS, C. F., *Correlations of Montana Algonkian formations.* Bull. Geol. Soc. Amer. **48:** correlation table and pp. 690–691. 1931.

[10] LANGTON, C. M., *Geology of the northeastern part of the Idaho batholith and adjacent regions in Montana.* Journ. Geol. **43:** fig. 3. 1935.

[11] DEISS, CHARLES, *Stratigraphy and structure of southwestern Saypo quadrangle, Montana.* Bull. Geol. Soc. Amer. **54:** 211–218. 1943.

[12] PEALE, A. C., *Three Forks Folio.* U. S. Geol. Survey, Geol. Atlas of the United States, Folio 24. 1896.

[13] TANDEY, WILFRED; SCHAFER, P. A.; and HART, L. H., *A geological reconnaissance of the Tobacco Root Mountains, Madison County, Montana.* Montana Bur. Mines and Geol. Mem. 9. 1933.

[14] BERRY, G. W., *Stratigraphy and structure at Three Forks, Montana.* Bull. Geol. Soc. Amer. **54:** p. 6. 1943.

[15] PERRY, E. S., Personal letter of Oct. 24, 1947.

ing Committee were read and approved. Officers for the year 1948 were then elected:

President: W. W. RUBEY.

Vice-Presidents: J. S. WILLIAMS and K. E. LOHMAN

Secretary: DONALD DOW (for two years)

Treasurer: CHARLOTTE A. MARSH

Council: R. P. BRYSON, E. C. CABOT, HELEN CANNON, D. H. DUNKLE, GEORGE O. GATES

The Society nominated W. W. RUBEY to be a Vice-President of the Washington Academy of Sciences for the year 1948.

GEORGE T. FAUST, *Secretary.*

Obituaries

NELSON HORATIO DARTON, internationally known geologist and member of the U. S. Geological Survey for 50 years, died on February 28, 1948, after a brief illness, at his home in Chevy Chase, Md. He was born on December 17, 1865, in Brooklyn, N. Y. At the age of 14 he quit public school to become an apprentice in his uncle's pharmaceutical establishment, where by diligent application and study he acquired a considerable reputation as a practical chemist. Mineral specimens in his uncle's cabinet aroused his interest in the rocks around New York City, which prompted many field trips and caused him to prepare a card catalog of papers on the geology of that region. Out of these activities grew an acquaintance with professional geologists, in particular with the noted G. K. Gilbert, of the U. S. Geological Survey, who persuaded him to join the Survey in 1886. Darton's first project was the compilation of a bibliography of North American geology, the forerunner of a valuable series of volumes.

Field work presently took Darton into many parts of the Eastern States, where he investigated water resources and prepared many maps. Similar water, coal, gas, oil, and other geologic studies occupied him for many years in the Western States, Mexico, and Venezuela. In much of this work he was a pioneer, having to make his own topographic bases for geologic mapping. The results of all this indefatigable travel and work are concentrated in more than 200 publications, including 26 Geologic Folios, 7 Professional Papers, and 27 Bulletins of the U. S. Geological Survey. Many of these publications became famous, some almost achieving the rank of best-seller, as, for example, *Story of the Grand Canyon* and *Guidebook of the Western United States: The Sante Fe Route.* He regarded U. S. Geological Survey Professional Paper 32, *Preliminary report on the geology and underground water resources of the Central Great Plains,* as one of his best papers. His last work deals with the geology of the District of Columbia.

In 1922 Darton received the Sc.D. degree from the University of Arizona; in 1930 the Daly gold medal of the American Geographical Society; and in 1940 the Penrose medal of the Geological Society of America. Among his many scientific affiliations, he was an honorary member of the American Association of Petroleum Geologists, an original Fellow of the Geological Society of America, a founder and president of the Geological Society of Washington, a founder of the Association of American Geographers, and a founder of the Washington Academy of Sciences.

Dr. Darton had a gracious personality. As a public speaker he enlisted the hearers' attention not only by his orderly presentation of interesting facts but also by his excellent command of language and a pleasing platform manner. His last appearance was in an address to the Geological Society of Washington on February 11, 1948.

He was buried in Mount Olivet Cemetery in Washington, D. C. Surviving him are his wife, one daughter, and two sons.

ROLAND W. BROWN.

HORACE TERHUNE HERRICK, one of the country's leading authorities on the industrial utilization of agricultural commodities, and special assistant since January 1, 1946, to the chief of the Bureau of Agricultural and Industrial Chemistry, died at his home in Washington, D. C., on October 7, 1948, after a long illness. He had retired because of disability less than two months earlier.

Mr. Herrick had been a leader in research on the utilization of agricultural commodities since he entered Government service in 1926. As Assistant Chief of the Bureau of Agricultural Chemistry and Engineering from 1938 to 1942 he was in charge of planning, building, and staffing

the four large regional research laboratories devoted to finding new uses and wider markets for farm products. From 1942 to 1946 he was director of the Northern Regional Laboratory in Peoria, Ill. The fermentation research at this Laboratory, which was a continuation of work initiated under Mr. Herrick's direction in 1927 when he was chief of the Color and Farm Waste Division, helped to make possible the commercial production of penicillin during World War II.

In 1946 Mr. Herrick returned to Washington as special assistant to the chief of the Bureau of Agricultural and Industrial Chemistry, of the Agricultural Research Administration, successor to the Bureau of Agricultural Chemistry and Engineering. His wide personal acquaintance with industrial users of agricultural materials made possible the maintenance of close cooperative relations with manufacturers and food processors who benefited from the Bureau's research results and assisted in commercial tests of new products and processes developed in its laboratories.

Previous to entering the United States Department of Agriculture, Mr. Herrick had more than 15 years of experience in the manufacture of industrial chemical products, such as illuminating gas, dyes, and fine and heavy chemicals. He was a lieutenant-colonel in the Chemical Warfare Service Reserve between World War I and World War II.

Born in Brooklyn, N. Y., in 1887, Mr. Herrick was the older son of James Frederick Herrick, telegraph editor of the *New York World*, and Christine Terhune Herrick, writer and author. He was a nephew of the late Albert Payson Terhune, well-known writer of dog stories. Mr. Herrick was a prolific writer and the author of numerous articles on fermentation and the industrial utilization of agricultural commodities. After attending Lawrenceville School in Lawrenceville, N. J., he received the A.B. degree from Princeton University and the degree of Chemical Engineer from Columbia University. He was a member of the American Chemical Society, the Cosmos Club of Washington, the American Institute of Chemical Engineers, the Washington Academy of Sciences, the Chemical Society of Washington, Sigma Xi, and Alpha Chi Sigma.

Mr. Herrick is survived by his widow, the former Cecile Debouy, and one daughter, Miss Cecile Herrick, both of Washington; also by two sons, Snowden Terhune and Horace Terhune, Jr., by a former marriage to Elinore Morehouse Herrick, and by one brother, James F. Herrick, a writer.

JOSEPH ALFRED AMBLER, Department of Agriculture organic chemist and authority on sugar chemistry, died suddenly on October 6, 1948, in New Orleans, La. He was born on June 30, 1889, in Danbury, Conn., and was a graduate of Yale University, where he received the bachelor degree in 1910 and the doctorate in 1913. Before entering government service, he taught chemistry for three years at Acadia University in Wolfeville, Nova Scotia.

Dr. Ambler had 30 years' service in the Department of Agriculture, which he entered in 1917 as a chemist in the Color Laboratory of the Bureau of Chemistry, Washington, D. C. He headed this laboratory from 1922 to 1925 and made important contributions to fundamental knowledge of coal-tar dyes, particularly those used in food products. He was also associated with the development of methods for producing furfural from corncobs. After a year's absence from the Department, Dr. Ambler returned to the Bureau of Chemistry's Carbohydrate Research Division in Washington. He conducted fundamental investigations in this division from 1926 to 1937 on the minor constituents of sugar beets, sorgo, and sugarcane. His work in determining the effects of contaminants in commercial sugar products was outstanding.

In 1940, the Carbohydrate Research Division was combined with the Food Research Division to form the Division of Agricultural Chemical Research, in which Dr. Ambler continued his research on carbohydrates. Since 1943, this division has been housed in the bureau's Southern Regional Laboratory at New Orleans. Dr. Ambler was made chief of the Organic Chemical Section of the division in July 1948. His recent investigations were concerned primarily with the recovery and utilization of aconitic acid from sorgo and sugarcane. He was co-inventor of the basic process for extracting aconitic acid from these crops; also he contributed to development of a method for direct production of itaconic acid from calcium aconitate.

For a number of years, during his residence in Washington, Dr. Ambler lectured on the chemistry of carbohydrates and proteins at George Washington University. He was a member of the American Chemical Society, Alpha Chi

Sigma, Sigma Xi , and the Washington Academy of Sciences. He is survived by his wife, Mrs. Flossie Belle Holloway Ambler, and by a son, George C. Ambler, of Falls Church, Va.

HAROLD WATSON MURRAY died on June 15, 1948, at the age of 41 years in the midst of an active professional career and at the full tide of his scientific endeavors. The great loss to his family and friends is also sadly felt by his associates who cooperated with him in his hydrographic and oceanographic studies. His knowledge and understanding of the configuration of the continental shelves and ocean bottoms had only in part been presented in the monographs he authored. His writings bear witness alike to that patient and indefatigable zeal in independent research and to the pioneering spirit which he brought to a field that has so recently begun to yield its secrets. Had he lived, his future contributions in the field of oceanography would certainly have been of immeasurable value. May we, who are keenly aware of the value of his research, continue probing the mysteries of the lands beneath the seas.

Mr. Murray was born in East Avon, N. Y., on October 6, 1906, son of Charles Howard and May Schultz Murray, and together with his sister, Gladys S., lived his early years in the town of his birth and in Pottsgrove, Pa. His family subsequently moved to Milton, Pa., where he returned frequently for short vacation periods in recent years.

After graduation from Milton High School he entered Bucknell University and in 1929 received his bachelor's degree in civil engineering. He then accepted a position with the U. S. Coast and Geodetic Survey and was chief of the Hydrographic Surveys Section at the time of his death.

His interest in hydrography and oceanography is attested by his further graduate studies at George Washington University. His early oceanographic work in the Survey was in association with Paul A. Smith and A. C. Veatch in the delineation of the continental shelf on the Atlantic coast. He was well equipped for these scientific studies, as his was a keen and analytical mind, and he pursued each newly discovered oceanographic feature from the first indication of its existence to its complete portrayal. The results of some of his studies were presented in three monographs.

Mr. Murray was a fellow of the Geological Society of America, a member of the American Geophysical Union, the Philosophical and Geological Societies of Washington, the American Congress on Surveying and Mapping, and the Washington Academy of Sciences. He represented the Coast and Geodetic Survey on the subcommittee on sedimentation, Federal Inter-Agency River Basin Committee. He was a Presbyterian, a Mason, and an officer in Trinity Lodge F.A.A.M., and was a member of Albert Pike Consistory, M.R.S., and Almas Temple, Washington, D. C.

His research work was his chief hobby, as his able and conscientious nature seemed to provide a driving force almost exclusively in that direction. His daily work in the Coast and Geodetic Survey furnished the basic material which could be studied and assembled into a portrayal of previously unrevealed submarine topography. His spare time at home was thus spent to a considerable extent in pursuit of his life work. He took up aviation and needed only a few hours of solo flying to qualify for his pilot's license. But again, it is felt he wished to fly in order to obtain an additional perspective of land formations in connection with a better understanding of submarine topography.

In addition to his widow, Mabel F. Murray, he is survived by two young sons, H. Martin and Harold W., Jr.

BIBLIOGRAPHY OF HAROLD WATSON MURRAY

Submarine scarp off Mendocino, California. Field Engineers Bull. Coast and Geodetic Surv. no. **13**: 27–33. 1939.

Submarine mountains in the Gulf of Alaska. Bull. Geol. Soc. Amer. **52**: 333–362. 1941.

Profiles of the Aleutian Trench. Bull. Geol. Soc. Amer. **56**: 757–782. 1945.

Topography of the Gulf of Maine, field season of 1940. Bull. Geol. Soc. Amer. **58**: 153–196. 1947.

GEORGE F. JORDAN.